E. M. Baker

The Monthly Review of the AMERICAN ELECTROPLATERS' SOCIETY

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NOVEMBER 1941

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Editorial

All members of the A.E.S. are keenly interested in the decisions made by the Office of Production Management at Washington relating to the metals used for electroplating. Under date of October 27, 1941, the following order was issued:

Part 981 — Passenger Automobiles

Supplementary General Limitation Order L-2-b

Further Restricting the Production of Passenger Automobiles

In accordance with the provisions of section 981.1 (General Limitation Order L-2), which the following Order supplements, IT IS HEREBY ORDERED THAT:

981.3 (a) *Elimination of "Bright Work."* On and after December 15, 1941, no producer shall use any "bright work," "bright finish," metal finish, or body trim containing copper, nickel, chrome or aluminum in the production of new passenger cars, *provided, however*, that permission to use these materials in the plating of bumpers and in the plating of bumper guard assemblies may be given upon a showing that such use will utilize all possible conservation measures and will be restricted to minimum practicable quantities. Applications for such permission shall be made by a letter addressed to the Chief of the Automotive, Transportation, and Farm Equipment Branch, Division of Civilian Supply. Effective immediately, no producer shall produce such "bright work," "bright finish," metal finish, or body trim containing copper, nickel, chrome or aluminum except in amounts necessary to complete passenger automobiles scheduled to be completed before December 15, 1941.

In addition to the restrictions on the use of nickel, another order has been issued under date of October 21, 1941, regarding restrictions on the use of copper for plating purposes. The order reads as follows:

Part 933 — Copper

Conservation Order No. M-9-c

Curtailing the Use of Copper in Certain Items

WHEREAS, national defense requirements have created a shortage of Copper for the combined needs of defense, private

account, and export; action has already been taken to increase and conserve the supply and to direct the distribution of Copper to insure deliveries for defense and essential civilian requirements; and the supply of Copper now is and will be insufficient for defense and essential civilian requirements unless the use of Copper in the manufacture of many products where such use is not absolutely necessary for the defense or essential civilian requirements is curtailed or prohibited;

NOW, THEREFORE, IT IS HEREBY ORDERED THAT:

(a) RESTRICTIONS ON USE OF COPPER IN ARTICLES APPEARING ON LIST "A"

(1) Curtailment to January 1, 1942. Except as provided in paragraph (c) hereof, during the period between October 15 and December 31, 1941, no Manufacturer may use in the aggregate in the manufacture of any Item on List "A" attached, more Copper or Copper Base Alloy than the greater of the following two limits:

(i) One half of the total amount of Copper or Copper Base Alloy, respectively, used by him in the manufacture of such Item during the last three months of 1940, or

(ii) One-eighth of the total amount of Copper or Copper Base Alloy, respectively, used by him in the manufacture of such Item during the year 1940.

If any Manufacturer is manufacturing any such Item which he did not manufacture in 1940, then during the period between October 15 and December 31, 1941, he may use in the manufacture of such Item Copper or Copper Base Alloy to a total amount not exceeding 50% of the total amount used by him in the manufacture of such Item during the period between August 1, and September 30, 1941.

(2) *Prohibitions after January* 1, 1942. Except as provided in paragraph (a) (3) and in paragraph (c) hereof, after January 1, 1942, no Manufacturer of any Item on List "A" attached, may use in the manufacture of any such Item any Copper or Copper Base Alloy.

(3) *Substitution of Plating in Limited Cases.* Nothing contained in this paragraph (a), however, shall prevent the use of Copper or Copper Base Alloy for plating any Item included on List "A," provided

(i) that such plating is not primarily for decorative purposes, and

(ii) that the use of or the normal wear on such Item would make impractical any other form of coating, and

(iii) that such Item was formerly plated with Copper or Copper Base Alloy, or if such Item was not formerly so plated, then provided that the total amount of Copper or Copper Base Alloy to be used in the plating of such Item is less than 5% of the amount that was used in the manufacture of each such Item immediately preceding the effective date of this Order.

Inasmuch as our government in making these decisions is looking far ahead, maybe for several years, it behooves all plating plant owners to get into defense work as soon as possible in order to help the Defense program and at the same time reduce unemployment to a minimum. Meanwhile the officers of the A.E.S. are doing all in their power to arrange a meeting between the OPM and representatives of the electroplaters, manufacturers, and supply houses. Such a meeting when held will be used to give the officials in Washington valuable information as to the platers' requirements and will further assure the OPM that we are anxious to do our part in the present program. We believe that such a meeting will be held soon. Further information regarding it will be given to our readers through the REVIEW.

CIVILIAN DEFENSE

"Pots and pans" collection yields enough aluminum for over 1,900 fighter planes.

From *Defense*, September 30, 1941

The Nation's housewives donated to the Government from July 21 to 29 enough aluminum to make more than 1,900 fighter planes or 350 four-motored bombers, it was announced September 24 by the Office of Production Management and the Office of Civilian Defense.

With returns from the Nation nearly all in, the estimated gross collection total of "pots and pans" amounted to 11,835,139 pounds, or about one-third of a pound per occupied dwelling. Office of Production Management experts estimated this would yield about 7,000,000 pounds of aluminum for defense production. The balance between these two figures represents other materials, primarily iron and steel, which were attached to the aluminum articles.

Of the gross collection 97.4 percent or all but 310,000 pounds, already has been allocated to smelters having defense preference ratings. This assures the use of the aluminum collected in defense plants. The highest gross collection of any state was recorded by New York where housewives contributed 1,050,000 pounds of pots and pans. Second highest State was Pennsylvania with a recorded total of 900,000 pounds, and Massachusetts was third with 699,150 pounds. Highest contributors per dwelling was reported by Rhode Island where 1.088 pounds per occupied unit were contributed to the collection. Second highest per dwelling contribution was reported by Nevada with 0.744 pound per unit, and Utah was third with 0.716 pound per dwelling.

The total collected throughout the Nation fell considerably below OPM estimates. These estimates were based upon the per capita yield from test campaigns conducted in Richmond, Va., and in Dane County, Wis., which campaigns were organized thoroughly and conducted intensively. Several factors apparently contributed to a less successful yield throughout the Nation. Besides yielding enough aluminum to materially improve an emergency shortage of scrap metal at defense smelters, the campaign has taught valuable lessons for the guidance of OPM officials in planning for the salvaging of other scrap and waste materials.

A.E.S. RESEARCH CLEARING COMMITTEE

Mr. Erwin Sohn, Chairman of the Research Committee, has requested the writer to form a separate committee for the purpose of acting as a clearing house of information that will be of benefit to members of the A.E.S. in the present emergency. This committee will function under the sponsorship of the Research Committee, and any information or ideas that may develop will be passed along for that committee's consideration and possible action. The other members of the Research Clearing Committee are Ellsworth Candee, William Blum, W. J. R. Kennedy, Walter Pinner, Erwin Sohn.

It is hoped that the membership of the A.E.S. will make full use of this new service and will contribute many suggestions.

As a starting point in securing definite, concrete information that should prove of mutual benefit to society members, a questionnaire has been prepared which we would like every member to fill out and forward to Mr. W. J. R. Kennedy, Executive Secretary. All answers will be treated confidentially, since the purpose is to develop information leading ultimately toward increasing electroplating applications for defense items, by calling attention of designers and contractors to the necessity for protection against corrosion, and steering such work toward electroplating plants with good locations and having adequate facilities. Your cooperation in this will be greatly appreciated whether or not you are engaged in plating for defense purposes.

— R. O. HULL, Chairman, Research Clearing Committee.

QUESTIONNAIRE FOR RESEARCH CLEARING COMMITTEE

1. Name of Plant.....
2. Location.....
3. Kinds of Plating Baths used:

Copper, acid.....		Cyanide.....	
Nickel, dull.....		Bright.....	
Chromium, decorative.....		Hard.....	
Cadmium.....			
Zinc, acid.....		Cyanide.....	
Tin, acid.....		Alkaline.....	
Brass.....			
Others:.....			

4. Types of articles plated.....
5. Gallons of each plating bath available for additional work (indicate "B" for barrel, "S" for still):

Copper, acid.....Gal.		Cyanide.....Gal.	
Nickel, dull.....Gal.		Bright.....Gal.	
Chromium, decorative.....Gal.		Hard.....Gal.	
Cadmium.....Gal.			
Zinc, acid.....Gal.		Cyanide.....Gal.	
Tin, acid.....Gal.		Alkaline.....Gal.	
Brass.....Gal.			
Others:.....Gal.			

6. Is personnel available for increased production?.....
7. Is plant equipped to do specification plating, and provided with apparatus for testing deposits?.....
8. Is your present volume of work sufficient to keep your plant operating profitably?.....
9. Would you be interested in adding to your production?.....

Please fill out questionnaire and return to Mr. W. J. R. Kennedy, 93 Oak Grove Avenue, Springfield, Mass.

Signed..... Position.....

Magnesium *in the* National Defense

Presented at the National Defense Symposium, Chicago, May 20, 1941.

By L. B. GRANT

This paper was published in Volume 37, #3, June 25, 1941, Transactions, American Institute of Chemical Engineers.

To understand the position of magnesium metal in the present National Defense Program, it is necessary to review the development and growth of the United States magnesium industry since its inception in 1915. At that time the uses for magnesium were very limited and the market, consequently, very small. The total United States production in 1915 was 87,500 pounds valued at $440,000.00. Sales were principally in the form of powder which was used for tracer shells, aerial bombs, and rockets; and magnesium powder was chosen for these uses because it burned with a brilliant, white light. World War I gave a marked impetus to the magnesium industry because these flares and bombs were used extensively by the Allies in their military operations and consequently United States consumption rose to 284,000 pounds in 1918 and then dropped abruptly with the close of the War.

Leading manufacturers felt at this time that there might be a potential market for peacetime purposes, but the obstacles were large and a survey of the factors involved in the manufacturing and marketing of magnesium did not look promising. The following table summarizes these more important favorable and unfavorable factors as they appeared in 1918:

Favorable Factors	*Unfavorable Factors*
1. Light weight (specific gravity 1.74).	1. High production cost.
2. Abundance of raw material from which to manufacture.	2. Poor mechanical properties.
3. Good machinability.	3. Poor corrosion resistance in salt water.
4. Certain chemical characteristics (deoxidizer and Grignard reagent).	4. No known methods of fabrication.
5. Pyrotechnic qualities.	5. No information on design structures.
	6. Lack of service data.
	7. Lack of markets requiring light weight.

One may well ask how a material with so many disadvantages has become an important, vital part of our National Defense

Program of today. The answer lies in the continuous effort by the magnesium industry during the past 25 years to overcome

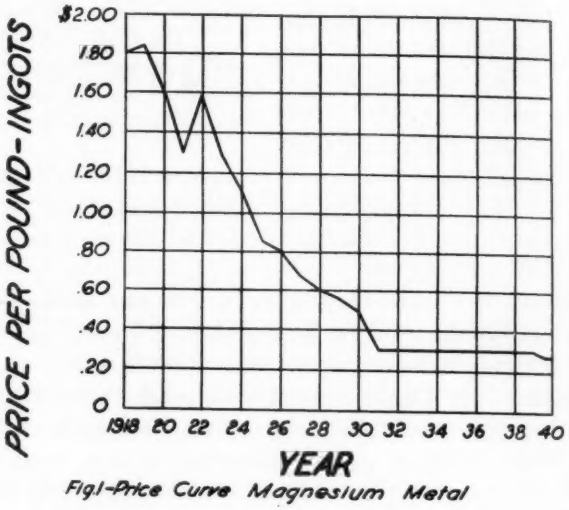

Fig1-Price Curve Magnesium Metal

these disadvantages by improvement of magnesium production and fabrication processes, by metallurgical research, and by a marketing and sales development program always prompted by the firm belief that magnesium some day would become an important structural metal and would, in addition, find an increasing field of application because of its unique chemical and metallurgical properties.

Production Cost

The average selling price of magnesium in 1918 was $1.81 per pound, and it was apparent that it could not compete at that price with other structural metals even though it were equal or better than these metals in other respects. The above price curve (Fig. 1) taken from Bureau of Mines statistics indicates what has been accomplished in reduction of production costs from 1918 to 1940.

Mechanical Properties

Magnesium, like most other pure metals, is soft and has low mechanical properties. It was, therefore, necessary to carry on a continuous and extensive research program for many years to

develop alloys high in magnesium content that could compete in structural uses with other metals. Thousands of combinations have been made and tested and as a result alloys are now available that can meet competition, especially where a low weight-strength ratio is required. It has been found that zinc, aluminum, and manganese are generally the most useful for alloying with magnesium and the Government-approved alloys of today all contain one or more of these alloying metals. The table on page 872 gives the composition and more important mechanical properties of the magnesium alloys now in common use in the National Defense Program.

Corrosion Resistance

The corrosion resistance of magnesium alloys has long been a favorite subject of discussion among metallurgists, and most of their unfavorable comments had some justification based on facts as known in the early stages of development. The magnesium industry attacked this problem and soon found that work was necessary on:

1. The elimination of chloride flux inclusions.
2. The development of alloys having inherently better corrosion resistance.
3. The control of harmful metallic impurities.
4. The development of suitable chemical surface treatments.
5. The development of better paints and painting schedules.

Practically all melting of magnesium alloys is carried out under protective fluxes and these fluxes usually contain chlorides which if entrapped in the metal greatly accelerate corrosion. The development of better fluxes and of better handling technique has conquered this problem so that corrosion due to flux inclusions is now non-existent.

It was indeed fortunate that some of the same alloying metals that improved mechanical properties also increased corrosion resistance. Both zinc and manganese, if used in the right proportion, accomplish this purpose and present alloy compositions are designed to meet both strength and corrosion resistance requirements. It is interesting to note that the Army Air Corps never felt that magnesium alloys had sufficient corrosion resistance for use in airplane parts until they specified the present zinc-bearing alloys about 1938.

Table I.—Typical Properties of Magnesium Alloys

Property	Sand Castings Dowmetal *H-HHT* Army Air Corps Spec. 57-74-1*C* Navy Aeronautical Spec. *M*-112*g*	Die Castings Dowmetal *R* Army Air Corps Spec. 11319 Navy Aeronautical Spec. *M*-369	Extruded Shapes Dowmetal *J*-1 Army Air Corps Spec. 11320 Navy Aeronautical Spec. *M*-314*c*	Press Forgings Dowmetal *J*-1 Army Air Corps Spec. 11321 Navy Aeronautical Spec. *M*-126*d*	Sheet Dowmetal *J*-1*a* Army Air Corps Spec. 11317-*A* Navy Aeronautical Spec. *M*-111*e*
Ultimate tensile strength, psi.....	39,000	33,000	43,000	44,000	40,000
Tensile yield strength,* psi.....	12,000	21,000	28,000	28,000	25,000
Elongation in 2 in. per cent.....	12	3	12	13	15
Brinell hardness.....	53	60	58	58	—

*Yield strength is defined as the stress at which the stress strain curve deviates 0.2% from the modulus line.

One of the most important researches in recent years shows that the resistance of magnesium alloys to salt water is greatly affected by extremely small amounts of metallic impurities and critical allowable amounts of these impurities in standard alloys have now been definitely determined. As a result of this work, alloys for die castings, extrusions, sheet, and forgings are now produced with maximum iron content of .005% and maximum nickel content of .005%. The photograph in Fig. 2 shows two test

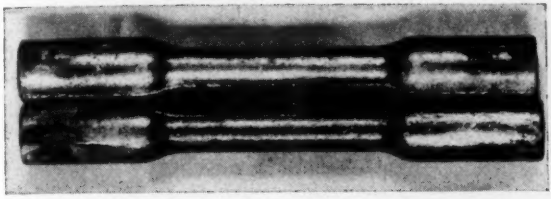

FIG. 2. High Purity Casting Alloy Test Bars After Six Months' Alternate Immersion in Salt Water.

bars of Dowmetal "*H*" alloy with controlled iron and nickel content and after 6 months' exposure to salt water.

It has long been known that certain surface chemical treatments have improved the corrosion resistance of magnesium alloy parts and the best known treatment until the past two or three years was the so-called "chromate" or "chrome pickle" treatment which consisted of immersing the article for a short period in a solution of nitric acid and sodium dichromate. However, this treatment was difficult to control and attacked the metal surface, thereby causing change of dimension and its protective qualities still left much to be desired. Many new treatments have since been perfected and one of the most efficient and commonly-used of these is known as the No. 7 treatment and is covered by United States Army Air Corps Specification 98-20010A part *E*-3*B*. It consists essentially of a 5-minute dip in a 15% to 20% solution of hydrofluoric acid followed by a 45-minute boil in a 10% solution of sodium dichromate. Magnesium parts thus treated take on a uniform brown to black coating which affords remarkable protection and which acts as a good base for subsequent painting.

Paint manufacturers and the magnesium industry have worked

together for years on the development of paints and painting schedules for magnesium alloys, this work including both short-time and long-time exposure tests to salt water and atmospheric conditions. As a result, paint schedules are now available that give good adhesion and protection. Figure 3 shows two mag-

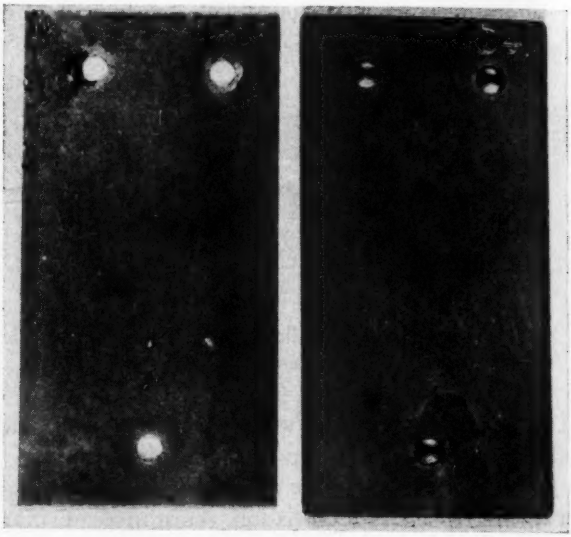

FIG. 3. Magnesium Painted Panels After Ten Months' of Tidewater Exposure.

nesium alloy panels after ten months' tidewater exposure and illustrates what can be accomplished with correct alloy composition, surface treatment, and painting. Magnesium alloy panels of twenty years ago subjected to the same conditions would be completely corroded away in a few weeks.

Fabrication Methods

It was not enough to develop alloys and surface treatments. Methods had to be found to fabricate these alloys into forms useful to industry. Attempts were first made to produce sand castings but the alloys were difficult to melt because they tended to burn in the molten condition, particularly at temperatures over 1300° Fahrenheit. It was found, however, that certain chloride mixtures or fluxes formed a protective layer on molten magnesium

in the melting pot and it is now as simple to melt and pour magnesium as any other metal. Great difficulties were encountered with magnesium when it was first poured into sand molds because the molten metal reacted with the water in the sand and burning and excessive gas evolution resulted. The first commercial castings were, therefore, made only in dry, baked sand molds which greatly limited the scope of castings to be economically produced.

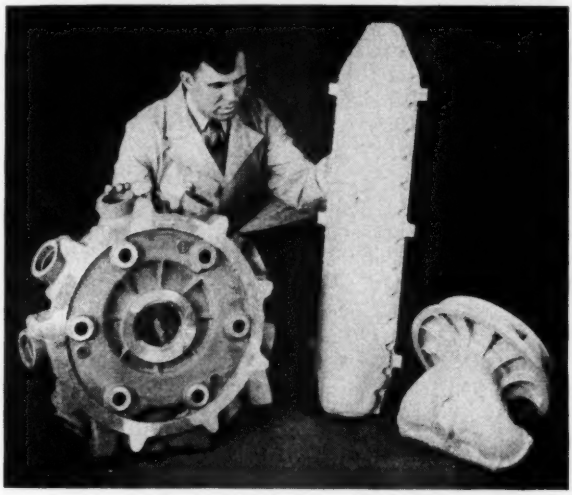

FIG. 4. Typical Magnesium Aircraft Engine Castings.

Work was started on the development of sand agents or inhibitors which would prevent this reaction with water and the results have been so successful that magnesium alloys can now be cast in green sand with no more difficulty than is encountered with aluminum or cast iron. These sand agents generally contain sulfur, fluorides or both which vaporize and form a protective gas blanket between the molten metal and the wet sand. Intricate castings of all sizes and shapes are now readily made. Figures 4 and 5 show typical aircraft engine and wheel castings which are being produced in large production quantities today.

It is estimated that approximately 6,000 to 8,000 men are now actively engaged in the production of magnesium sand castings for National Defense and this number will undoubtedly be much higher as the aircraft production program expands.

In a similar manner, problems incident to the production of magnesium alloys in wrought forms have been and are being solved so that magnesium alloys are now available in the form of die castings, extruded shapes, rod, tubing, forgings, and sheet.

Even after magnesium alloys became available in these forms, more work was necessary to determine methods for finishing and

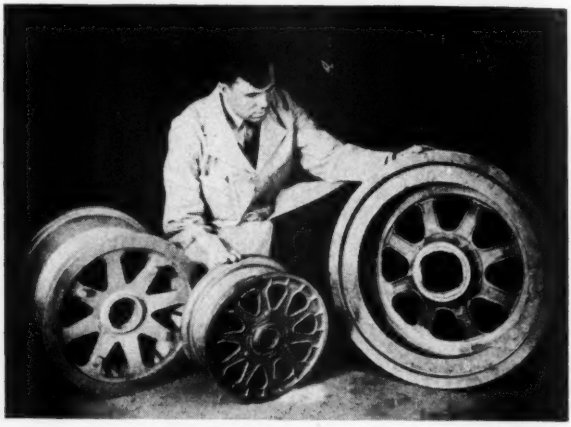

FIG. 5. Typical Magnesium Aircraft Wheel Castings.

assembling them into the ultimate usable product. As an example, although magnesium is one of the easiest of metals to machine, it was necessary to do extensive research work on design of cutting tools and on proper lubricants and cutting speeds in order to fully take advantage of the metal's good machining characteristics. Large machining shops having several years' experience in machining magnesium now report that greater production machining speed can be obtained on magnesium castings than on any other metal castings.

Magnesium sheet presented many difficulties in forming and drawing because of cracking when these operations were carried out at room temperatures. Alloy development has now made possible to perform many bending and forming operations at room temperatures and deep draws can now be made by working at carefully controlled elevated temperatures. Figure 6 shows typical aircraft parts made in this way.

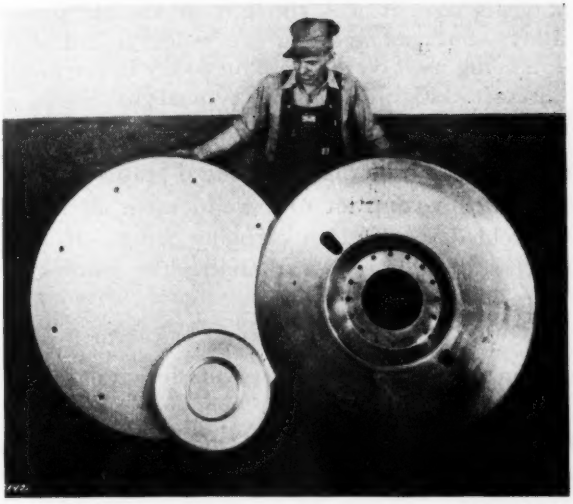

FIG. 6. Magnesium Formed Sheet Aircraft Wheel Fairing and Dust Cover.

FIG. 7. Gas Welding on Magnesium Aircraft Oil Tank.

Fifteen years ago, it was thought impossible to weld magnesium alloys, but gas welding, arc welding, and electric spot welding are being used on magnesium today in the production of military aircraft. Figure 7 shows a typical gas welding operation in an aircraft oil tank.

It is interesting to note that the United States Army Air Corps recently awarded a contract to a well-known aircraft company for an all-welded magnesium airplane wing. If this project proves successful, it may revolutionize the whole aircraft industry.

Design

In discussing the comparison between design data available to the engineers in the early days of magnesium alloys and now, mention should be made of the vast amount of strictly technical data now available as well as improved design practices from wider experience. For example, an early designer would be completely handicapped by lack of such essential data as ultimate and yield strength, elongation, hardness, etc. Today complete data on the chemical analysis and physical properties are readily available as well as experience for interpreting their value and influence on a finished design. It has been pointed out by J. B. Johnson (*J. Aero. Sc.* 6, 185 (1939)), that, for instance, fatigue endurance results on machined test bars have limited practical value because of the vast influence of notched effect and the fact that all assemblies, by virtue of rivets, bolts, etc., have notch effect present. To overcome this obstacle, the practice of vibrating completed assemblies has been adopted in order to check the fatigue endurance under service conditions. Such vibration and fatigue tests have been run on oil tanks and other aircraft sub-assemblies so that data is now provided on the desired details of welded joints, fitting attachments, etc., which provide the most satisfactory design. In the structural field, even the availability of the fundamental physical properties left the designer without sufficient data on column characteristics, strength of riveted joints, and other structural details necessary to make a completed design. Such information is now available.

Standards have been derived covering the proper relationship between diameters and length of studs and proper washer sizes for use with magnesium castings and proper methods of blending

and filleting casting intersections have been developed. In aircraft assembly much work has been done on proper insulation between faying surfaces of dissimilar metals so as to eliminate electrolytic corrosion. The above notes give a brief indication of some of the problems which have been attacked and which have yielded design data.

Service Data

It is interesting to look back at the sales approach of a few years ago when the magnesium industry was trying to introduce magnesium into structural uses. The usual sales arguments of light weight, good strength, and moderate cost were given but the potential customer invariably asked, "Has magnesium been used for this particular part before?" and the answer was necessarily, "No." There were, of course, certain pioneers in many industries who were willing to look ahead and take a chance on a new material, and it is these men to whom we are now largely indebted for the service data and experience gained by continued usage. One of the earliest uses of magnesium castings in this country was on aircraft inertia starters and this use has continued successfully through the years and has demonstrated the ability of magnesium castings to withstand long hard use. About 1930, a small airplane wheel manufacturer decided to experiment with magnesium wheels and dire results were prophesied, but that use has been successful and has grown, so that today magnesium wheels are used on the great majority of all modern military airplanes. These examples multiplied many times now form a firm basis on which the aircraft designer can specify magnesium with the knowledge that it will perform satisfactorily.

It should be mentioned that during these same years metallurgists in other fields have been developing uses for magnesium as an alloying material and as a deoxidizer for other metals. Most of the aluminum alloys used in aircraft today contain small percentages of magnesium, and this fact has greatly increased present magnesium consumption. The good properties and stability of zinc die castings are also dependent in part on the use of .02% to .04% magnesium. Nickel alloys use magnesium as an efficient deoxidizer and desulphurizer and substantial amounts of magnesium are used to remove bismuth from lead.

Present-Day Markets

There is no lack of market requiring light weight today because the aircraft industry which now utilizes magnesium to save weight is undergoing a tremendous expansion. It is estimated that approximately 1,000 pounds of magnesium are consumed per plane and this figure is steadily increasing as more and more aircraft parts are being designed in magnesium. With airplane production figures estimated at 4,000 per month in 1942, it can be seen that the magnesium industry is rapidly reaching vast proportions and that magnesium is indeed a vital material for National Defense. This is, of course, most gratifying to the men in industry who have spent these many years in developing a little-known laboratory curiosity into an essential, useful metal.

In summarizing the position of the magnesium in 1941, we now find that most of the unfavorable factors reported in this paper have been eliminated or reduced so that a present-day survey would show:

Favorable Factors

1. Light weight (specific gravity 1.74).
2. Abundance of raw material from which to manufacture.
3. Good machinability.
4. Certain chemical characteristics (deoxidizer and Grignard reagent.)
5. Pyrotechnic qualities.
6. Low production cost.
7. Good mechanical properties.
8. Good corrosion resistance in salt water.
9. Well developed methods of fabrication.
10. A background of design information.
11. Twenty years of service data available.
12. Tremendous airplane market requiring light weight.

This table of favorable factors should not be construed to mean that the task is completed. In fact, it is believed that advances in the technology of magnesium have only started and that the future will show improvements in metallurgy and manufacture and a widening of uses that are undreamed of today.

Nickel Plating - Old and New

By W. M. TUCKER
Eastman Kodak Company,
Roll Coating Dept.

ANY effort to cover the subject of nickel plating completely in a short paper would be relatively impossible and undesirable. Therefore, it seemed imperative to limit the ground covered in this paper, and consequently it is the purpose of this paper to present a brief history of nickel plating. We are much indebted for our material to Mellor's "Treatise on Inorganic Chemistry", "Transactions of the Electrochemical Society," Langbein's "Electro-deposition of Metals," and to the Patent literature.

In 1842 a German, R. Boëttger by name, first electroplated nickel. The baths used were either nickel ammonium sulfate or an ammonical solution of nickel sulfate. Boëttger described the plates he obtained by saying that they were bright and dense. In addition he pointed out the obvious advantages of such a coating of nickel.

After so promising a start, one would suppose that nickel plating would progress very rapidly; however, it seems that Boëttger's research was forgotten. No definite cause can be given for this. At any rate the first recorded commercial application of nickel plating seems to have occurred in Boston, Mass., during the winter of 1865-1866. During that winter Isaac Adams operated a twenty-gallon nickel solution. This solution contained nickel ammonium sulfate and used cast nickel anodes. Mr. Adams nickel plated several hundred gross of cast iron and brass gas tips in this solution. Later, in 1869 he was granted the first U.S. patent for nickel plating.

During the winter of 1868-1869 a certain William H. Remington set up a large nickel plating plant in Boston. This plant operated somewhere between 400 and 500 gallons of nickel plating solution. As would be expected, the baths were of the nickel ammonium sulfate type. Incidentally Mr. Remington seems to have been an eccentric. He was addicted to spiritualism and used it to control his nickel plating solutions. This method of control coupled with Mr. Remington's pioneering spirit with regard to the use of vegetable addition agents ulti-

mately resulted in his retirement from the business shortly after a large addition of skunk cabbage had been made to his solutions. Mr. Adams seems to have carried on from this point with the same concern and as a matter of interest this company is still functioning today under the name of the Boston Nickel Plating Company.

During the interval from 1870 to 1900 the progress of nickel plating was rapid in the sense that a great amount of original research was carried out. The chief results were a multitude of plating solutions based upon virtually all of the water-soluble salts of nickel. Incidentally in 1878, U.S. Patent 211,071 was issued to Edward Weston. This patent is a milestone in the history of nickel plating because it claimed great advantages for the use of boric acid either to replace ammonium salts completely or in part in nickel plating solutions. The use of boric acid was so controversial that even as late as 1905 Langbein condemned its use.

At the turn of the century the following plating baths according to George Langbein represented the best available:

Slide I

Nickel ammonium sulfate — $NiSO_4 . (NH_4)_2SO_4 . 6H_2O$—9.25 oz./gal. 69 gm./L.
Ammonium sulfate — $(NH_4)_2SO_4$—3.0 oz./gal. 22.5 gm./L.
Citric acid —0.67 oz./gal. 5.0 gm./L.

Operate neutral to slightly acid
Room temperature
Current density — 3.2 A.S.F.
Cast nickel anodes

Langbein calls the bath formula given on Slide I a typical commercial nickel bath.

Slide II

Nickel ammonium sulfate — $NiSO_4 . (NH_4)_2SO_4 . 6H_2O$—8.33 oz./gal. 62.5 gm./L.
Ammonium chloride — NH_4Cl—4.25 oz./gal. 32 gm./L.

Operate neutral to slightly acid
Room temperature
Current density—5.1 A.S.F.
Cast nickel anodes

Langbein warns that this bath must not be used to plate upon

iron because if it is, rusting will occur in a relatively short service period.

Slide III

Nickel chloride — $NiCl_2 . 6H_2O$—5.0 oz./gal. 37.5 gm./L.
Ammonium chloride — NH_4Cl —5.0 oz./gal. 37.5 gm./L.
Operate neutral to slightly acid
Room temperature
Current density—4.7 A.S.F.
Rolled nickel anodes

Langbein again cautions that this formula must not be used to plate iron. He specifically recommends this formula for use in plating zinc castings.

Slide IV

Nickel phosphate — $Ni_3(PO_4)_2 . 7H_2O$—2.5 oz./gal. 19.0 gm./L.
Sodium pyrophosphate — $Na_4P_2O_7 . 10H_2O$—10.5 oz./gal. 78.5 gm./L.
Operate slightly acid with phosphoric acid
Room temperature
Current density—4.7 A.S.F.
Cast nickel anodes

Langbein recommends this bath for use directly on iron, brass, copper, sheet zinc and zinc castings.

Slide V

Hot Nickel Bath
Foerster — 1897-1898

Single nickel salts — $NiSO_4 . 6\text{-}7H_2O$—20 oz./gal. 150 gm./L.
Operate bath neutral
Temperature—167-176°F.
Current density—18.6 to 23.3 A.S.F.
Cast nickel anodes

This solution must have been very hard to operate.

Slide VI

Langbein's Hot Nickel Bath

Single nickel salts — $NiSO_4 . 6\text{-}7H_2O$—49 oz./gal. 367 gm./L.
Sodium sulfate — $Na_2SO_4 . 10H_2O$—25 oz./gal. 187 gm./L.
Operate slightly acid with acetic acid.
Temperature—185-194°F.

Current density—37 A.S.F.
Cast nickel anodes

This bath could be used to deposit nickel up to 0.020" or more in thickness.

Slide VII

Weston Bath—U.S. Patent 211,071

Nickel chloride — $NiCl_2 \cdot 6H_2O$—3.5 oz./gal. 26 gm./L.
Boric acid — H_3BO_3 —1.4 oz./gal. 10.5 gm./L.
Operate much more acid than with other formulae
Room temperature
Current density—3-4 A.S.F.
Rolled or cast nickel anodes

Langbein criticizes this formula because it cannot be operated more than two or three months before it fails.

In 1916 at a national meeting of the American Electrochemical Society an interesting event occurred. Dr. Mathers and co-workers, Stuart and Sturdevant, presented a paper based on a very thorough study of the art of nickel plating. In this paper the development of the nickel ammonium sulfate bath was carried to its ultimate limit and the following formula presented:

Slide VIII

Mathers-Stuart-Sturdevant Bath

Nickel ammonium sulfate — $NiSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$—5.33 oz./gal. 40 gm./L.
Single nickel salts — $NiSO_4 \cdot 6\text{-}7H_2O$—13.3-18.7 oz./gal. 100-140 gm./L.
Boric acid — H_3BO_3 —1.33-4.0 oz./gal. 10-30 gm./L.
Magnesium chloride — $MgCl_2 \cdot 6H_2O$ —2.67 oz./gal. 20 gm./L.
or Nickel chloride — $NiCl_2 \cdot 6H_2O$ —2.67 oz./gal. 20 gm./L.
Ammonium citrate — $(NH_4)_3C_6H_5O_7$ —0.27-0.4 oz./gal. 2-3 gm./L.
Operate acid to litmus but neutral to Congo red.
Temperature—Room to 90°F.
Current density—15 A.S.F.
Anodes 99% electrolytic nickel with bags

This bath was a milestone primarily because it marked the culmination of the developments in nickel plating from its inception in 1842 until this moment. True, evidences of what was to come had been revealed in a fragmentary manner, but still a thorough research had demonstrated that the best available bath was still only a highly improved form of that used in the first successful deposition of nickel in 1842.

Immediately after the presentation of the Mathers-Stuart-Sturdevant paper, O. P. Watts presented a paper on nickel plating. This paper belongs to the modern era of nickel plating. Here in an interval of a few minutes we have the culmination of 74 years of research and experience made obsolete by the revelation of Watts. The formula described by Watts was as follows:

Slide IX

Watt's Bath — 1916

Nickel sulfate —$NiSO_4 \cdot 7H_2O$—240 gm./L.
Nickel chloride — $NiCl_2 \cdot 6H_2O$— 20 gm./L.
Boric Acid — H_3BO_3—20 gm./L.

Acidity—slight
Temperature—70°C.
Current density—70-100 A.S.F.

This formula, as doubtless most of you know, is the father of all the modern formulae used today. Of course it has been varied some in concentration and slightly in the amounts of the lesser constituents, but fundamentally we still have the Watt's formula.

Watts in his paper gives indirect credit to Kalmus and Barrows who in 1915 published the results of their researches upon cobalt. They demonstrated that the secret of high current densities was tied up intimately with salt concentration and by using the single sulfate of cobalt they were able to make up a solution which permitted operation as high as 150 A.S.F. It was during the stimulation in nickel research resulting from this work that Watts evolved his simple formula comprised of highly soluble nickel salts.

The art of nickel plating still lacked something. There was the elusive factor of acidity. With apparently the same acidity, different results sometimes were obtained. Efforts had been made to better this situation by using litmus and congo red

papers, but although there was an improvement, the control obtained did not seem to be narrow enough. In 1921 Dr. Blum of the Bureau of Standards proposed the use of pH to control solution acidity. The idea was good and later in 1924 one of Dr. Blum's co-workers at the Bureau of Standards published the complete details for pH control in nickel plating solutions. The method proposed was very simple and involved the use of the so-called drop-ratio colorimetric method. Thompson found pH 5.7 ± 0.3 to be the best commercial operating range. Many of you men are undoubtedly using this range today.

Pitting seems to have been a tough problem for a long time. The Watts type baths probably gave more pitting trouble than did the double salt formulae common to early nickel plating. A historic and probably still one of the most successful attacks was made on this problem more than a decade ago at which time the use of an oxidizing agent to prevent hydrogen pitting was suggested. Incidentally benefits were also alleged to be derived from oxidation of iron to the ferric form subsequent to its removal and also from the destruction of troublesome organic material by oxidation.

The progress of nickel plating in the period up to and including the early thirties was largely that of cementation of advances. The technique of pH control was highly refined. Much was found out regarding solution purification. Current densities increased. Equipment and supplies were refined and improved. However, really no fundamental forward steps were made.

The early thirties were marked by the development of several completely new type bright nickel plating solutions. Unlike the earlier types of bright nickel solutions these new baths were based on the Watts formula and generally used colloidal or semi-colloidal addition agents having comparatively small molecular weights. The plates obtained from these baths were generally quite ductile and had the property of gaining in brightness the thicker the deposit. Further, unlike the plates obtained from the old type baths using as brighteners, cadmium, zinc, gelatine, gum tragacanth, etc., the plates were not limited as to obtainable thickness. There are now a number of good bright nickel plating processes available. Undoubtedly you are fully aware of the savings to be realized from the use of a modern bright

nickel process. However, it should be mentioned that bright nickel plating demands excellent process control.

Along with the advent of bright nickel two new means for avoiding pitting became available. The first to be evolved was the use of a wetting agent which lowered the interfacial tension between gas bubbles and the solution and allowed the hydrogen or air bubbles to slide harmlessly off the work. The second, while largely a means of super-purification, can also be classed as a pitting depressant. It is the use of activated carbon or activated clay. They may, of course, be mixed together and used. Surface activated agents such as these act by adsorbing the many minute but amazingly active impurities which despite all our precautions will get into our solutions.

The common acceptance of the Watts formula and its relatives, today's bright nickel baths, has had a profound effect upon the electroplater's technique in handling both his solutions and his work. Today semi-hard to hard rubber lined steel tanks are most commonly used. Since all truly modern nickel plating baths require frequent filtration, the up-to-date plating solution will not only be continually circulated through a filter press, but it will in all probability be passed through an exterior heating device usually in the form of a small compact heat exchanger prior to its return to the plating tank. Temperature control will be automatic. If the job requirement is high, the filter press used will be charged with activated carbon or possibly activated carbon and acid activated clay. Of course, if a wetting agent is used, the carbon and active clay must be omitted. 99% + anodes will be used unless an alloy process is involved. These anodes will be special in nature, either rolled depolarized, cast with carbon as a residual element to facilitate anode corrosion, or possibly heat treated to develop a grain structure ideal for anodic attack. The solution temperature may range from 120°F. to 180°F. with current densities from 25 A.S.F. to 90 A.S.F. These high current densities have made common the usage of racks designed in much the same manner as are those for chromium plating. Although the throwing power of these solutions at high temperatures and current densities is excellent nevertheless certain precautions must be taken to guarantee a rack with adequate cross-section and with the work arranged in a favorable manner with respect to the anodes. Cleaning must be letter-

perfect primarily because imperfectly cleaned work appears far worse after bright nickel plating than it does before plating. Needless to say, control must be excellent since specification plating is an accepted fact.

Slide X

Single nickel salts — $NiSO_4 \cdot 6\text{-}7H_2O$—32-48 oz./gal. 240-360 gm./L.
Nickel chloride — $NiCl_2 \cdot 6H_2O$ —4-6 oz./gal. 30-45 gm./L.
Boric acid —4-6 oz./gal. 30-45 gm./L.
Wetting agents —as required
Brightening agents —as required
Temperature—130-170°F.
pH (Electrometric)—3.0 to 4.5
Current density—30-80 A.S.F.
Anodes—99%+ rolled depolarized usually.
Agitation—If demanded by process
Filtration—Yes

Slide X is the backbone formula which all our modern bright nickel processes use. The alloy processes for bright plating use the same basic formula also.

Slide XI

Wesley Nickel Chloride Bath

Nickel chloride — $NiCl_2 \cdot 6H_2O$—40 oz./gal. 300 gm./L.
Boric acid — H_3BO_3—4 oz./gal. 30 gm./L.
Anti-pitter—hydrogen peroxide as required
Temperature — 120-160°F.
pH (Electrometric)—1.5 to 4.0
Current density—50-100 A.S.F.
Anodes—Any form of 99% nickel
Agitation—Air preferably
Filtration—Desirable at high current densities

This is another interesting modern formula.

In conclusion, we have sketched through the history of nickel plating hitting what in our opinion constituted important steps forward. Naturally this paper is tainted with our opinions and quite probably you may not agree on some of the details; however, in the main the story is as free from controversy as possible.

The Fundamentals *of* Electrochemistry *and* Electrodeposition

IV. The Conductivity of Solutions.

Resistance and Conductance

By SAMUEL GLASSTONE
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WHEN the terminals of a battery, of a dynamo, or of any suitable source of electricity are connected by a conductor, either a metal or a solution of an electrolyte, an electric current flows through the conductor. The battery or dynamo exerts an electrical pressure or electromotive force (E. M. F.) which drives the electric current. The strength of the current flowing depends on the magnitude of this E. M. F. and also on a property of the given conductor called its "electrical resistance." This resistance opposes the flow of current and hence the greater the resistance the smaller the current. For electrochemical purposes it is more convenient to define a property known as the "conductance" or "conductivity" of an electrolytic solution; this is the reciprocal or inverse of the resistance. An increase of conductance thus permits a larger current to flow for a given applied E. M. F.; in fact, as will be seen shortly, according to Ohm's law, the strength of the current is directly proportional to the conductance.

Anode and Cathode

In order to pass an electric current through an electrolytic solution, it is necessary to insert two pieces of metal or other conducting material into the solution and to connect one to each pole or terminal of the battery or dynamo. These pieces of metal, etc., are called the "electrodes"; the one that is connected to the positive pole of the battery is called the "anode", while the other, attached to the negative pole, is called the "cathode." The positive electric current is said to flow *through the solution* from the anode to the cathode.

Anions and Cations

When a source of E. M. F. is applied to an electrolytic conductor, the positive ions which are present in the solution, as seen in the previous article, move in the same direction as the positive current, i. e., from anode to cathode. The negative ions move in the opposite direction, that is, from the cathode to the anode, through the solution. It is because the positive ions move toward the cathode that they are called "cations," whereas the negative ions, which travel to the anode are called "anions." In a solution of sodium chloride, for example, the sodium ions form the cations which move toward the cathode when an E. M. F. is applied; on the other hand, the chloride ions constitute the anions moving to the anode. In a nickel plating bath containing for example, nickel sulfate and ammonium chloride as the main constituents, the cations Ni^{++} and NH_4^+ travel to the cathode while the anions SO_4^{--} and Cl^- move in the opposite direction. In a complex silver cyanide bath, such as is used for the plating of silver, made up from silver cyanide and potassium cyanide, the K^+ ions are the cations and the anions are $Ag(CN)_2^-$ with some CN^- ions.

Discharge of Ions

It is necessary to call attention to the important distinction that must be made between the movement of the ions during the passage of current and the discharge of ions at the electrode, since this matter is so frequently misunderstood. When current passes through an electrolytic solution, *all* the ions present move in one direction or the other, according to the sign of the charge they carry. However, the particular ions that are discharged at the anode and cathode are determined by special conditions which will be discussed in a later article. For example, let us consider the nickel plating bath mentioned above. When current passes all the Ni^{++} and NH_4^+ ions move toward the cathode, but it is only Ni^{++} ions that are discharged at this electrode; none of the NH_4^+ ions, or practically none, are discharged. Nevertheless, these ions are being brought up to the cathode and since they are not discharged, they will accumulate there; hence they alter the environment from which the Ni^{++} ions are being discharged. This accounts for the familiar fact that salts which are added to a plating bath to improve its conductivity may have an influence on the form of the metal that

plates out. The ions collect near the cathode and so change the medium from which the plating occurs. Sometimes this change may be beneficial, but this is not necessarily true always.

Speeds of Ions

The ability of a solution to conduct the electric current, that is, its conductivity, depends on the movement of the various ions under the influence of the applied E.M.F. This conducting power is determined by the total number of ions in the solution —this depends on the concentrations of all the electrolytes, e. g., salts, acids, etc., that are present—and also on the speeds with which the ions move, or "migrate," when the E. M. F. is applied. Different ions generally move with different speeds; the faster an ion moves the greater the conducting power of the solution for a given concentration of ions. The hydrogen ion, present in acid solutions, and the hydroxyl ion, found in alkalis, have higher speeds than other ions; for this reason solutions of strong acids and alkalis are better conductors than solutions of salts. On the other hand, weak acids and bases are poor conductors, because they contain relatively few ions (see Part III, Oct., 1941).

Ohm's Law

The relation between the E. M. F. applied to a conductor and the current strength is given by Ohm's law, which may be expressed in the form of the simple equation $E = IR$, where E is the E. M. F. in volts, I is the current strength in amperes (amps.) and R is the resistance in ohms. If C is the conductance of the solution, then by the definition given previously it is equal to $1/R$, and hence replacement of R in the Ohm's law equation by $1/C$ gives the modified form $E = I/C$, or $I = EC$. It is seen, therefore, that the current strength I is proportional to the applied E. M. F. (E) and to the conductance (C).

For purposes of comparison it is convenient to use the "specific resistance," which is the resistance of a cube of 1 cm. side, and the "specific conductance," which is the reciprocal of the specific resistance. If k is the specific conductance of a particular solution, in which the electrodes, having an exposed area a sq. cm., are placed l cm. apart, then the actual conductance (C) of that solution with the given electrodes is equal to ka/l. If this value for C is inserted in the modified Ohm's law equation, the result

is $I = Eka/l$; if the applied E.. M. F. is known, together with the specific conductance of the solution, the size of the electrodes and their distance apart, it is possible to calculate the current strength. For our immediate purpose, however, it is the qualitative significance of this equation which is of greater interest; we can see that in order to increase the current strength for a given bath, we may increase the applied voltage (E), or the specific conductance (k) may be increased, for example by the addition of salts or acids. Another possibility is to increase a the exposed area of the electrode, or to decrease l, their distance apart. Improved conductance and increased current strength may thus be achieved by increasing the size of the electrodes and by bringing them closer together, as well as by adding conducting salts or by raising the E. M. F.

Here and There

ELECTROCHEMICAL SOCIETY MEETING IN CHICAGO

The Eightieth Meeting of the Electrochemical Society was held at the Knickerbocker Hotel, Chicago, October 1-2-3-4. From the standpoint of the Electroplaters' Society there was considerable interest. Over a dozen papers on Electroplating were read at the Technical Session on Friday and Saturday. R. O. Hull, E. I. DuPont de Nemours & Company, Cleveland, was Chairman. The papers read were most interesting and educational and created considerable discussion. So much so that toward the end discussions had to be limited because of the time. At these sessions there were 487 registrations, which speaks well for the interest in subjects relating to the plating field. Abstracts on the papers will be published in next month's REVIEW. A Luncheon in honor of Dr. O. P. Watts, honorary member of Chicago Branch A.E.S. was held on Saturday, Dr. C. F. Burgess presiding. George B. Hogaboom, one of the vice-presidents of the Electrochemical Society, spoke on "Dr. Watts, The Man."

While in Chicago, we visited Oscar Servis, past president of the A.E.S., in the Elizabeth Hospital. Oscar seemed very cheerful and hopes before long to get home again. May we suggest that those who have known Oscar for many years and appreciate his work as an active member of the A.E.S. remember him with a postcard or letter. We know such remembrances though little in themselves will be a great help in speeding his ultimate recovery. Address your mail as follows: Oscar E. Servis, 5305 Warner Ave., Chicago, Illinois.

Hartford Branch along with other branches of the Society is losing no time in getting classes started for an apprentice training course for platers at the request of Librarian Kenneth Bellinger. A meeting was held at the State Trade School in Hartford to discuss the possibility of starting such a course. Harry Hyman, field representative of the Federal Commission on Apprenticeship, Joseph Daly, Director, J. Stoll Trade School, Hartford, and Richard Howes, Assistant Supervisor State Trade and Industrial Training were present and addressed the meeting. Another meeting on the same subject will be held in the near future.

THE CANDEE-CRANE PARTY AT WATERBURY

There was a good attendance at the banquet, in honor of Ellsworth Candee, President of the A.E.S., and Dick Crane, Chairman of the International Fellowship Club, which was held at the Hotel Elton on Saturday evening, October 25th.

Ralph Coulter, President of Waterbury Branch and chairman of the committee introduced Thomas F. Slattery, Assistant Director of the Bureau of Engraving and Printing, Washington, D.C., as Toastmaster. A floor show followed the banquet after which Mr. Slattery introduced the following speakers: Frank J. Clark, Hanson-Van Winkle-Munning Co., one of the founders of the International Fellowship Club who, in his address, spoke of the advantages of the organization and mentioned that W. S. McKeon, Sulphur Products Co., was the founder of the club. Dr. Walter Meyer followed and substituted for Tom Trumbour, the Secretary of the club since its inception. Mr. Trumbour was unavoidably absent. Dave Clarin, Oakite Products Co., one of the Past Presidents, performed several sleight of hand feats, assisted by Paul Oldam of Newark Branch. Mr. Clarin congratulated both Messrs. Candee and Crane, on being elected to the highest offices in the A.E.S.

Joseph L. Downes, William Gray, and the Executive Secretary also spoke briefly on the high qualities of the two officers of the Society wishing them both a successful administration. Representatives from the various branches included in the 120 present were Ray O'Connor, Bridgeport, Edgar Luther, New Haven, Jack Costigan, Springfield, Andrew Garrett, Boston, Joel Backus, Hartford, George Wagner, Newark, Ralph Liguori and Franklyn MacStoker, New York. Past Presidents George Hogaboom, Horace Smith, T. F. Slattery, and Fred Fulforth were called upon to make a bow which they did very cheerfully.

Mr. Crane was given a golf bag as a token of appreciation while Mr. Candee will have a number of shrubs planted in the lawn of his new home at Watertown as a gift from his many friends and admirers. Mr. Candee's father was present as were many officials from the American Brass Company in Waterbury.

Mr. Slattery very appropriately brought the party to a close by singing two selections, "Your Friend" and "A Chip off the Old Block." Bill Starr of Lea Mfg. Co. accompanied Mr. Slattery at the piano.

SPRINGFIELD BRANCH MEETING AT PITTSFIELD

Springfield Branch held its regular meeting on Monday evening, October 27, at the Wendell Hotel, Pittsfield, Mass. The rain which threatened all day and which we have not had much of for the last few months, descended plentifully, but didn't keep many of the members from taking the trip to the Berkshire Hills.

Arthur Logozzo, Plastics Division of General Electric acted as technical chairman and introduced Dr. Uhlig of the Schenectady plant of General Electric who spoke on Electrolytic Polishing. Dr. Uhlig's address was listened to with great interest and provoked considerable discussion. The Doctor made everything very clear in answering questions on the subject, and was given a most generous hand as the meeting closed. Refreshments were served at the close of the meeting. There were 60 present.

At a short business meeting held after the above address, it was voted to appoint a committee to confer with the other New England branches regarding a desire on the part of the Springfield members to hold the regional educational Session and banquet in Springfield early in 1942.

For the unusually good attendance of this, the first meeting of the A.E.S. in Pittsfield as well as the other features (one of which was movies of the recent Boston Convention produced by Al Baker and Joe Barron), Mr. Logozzo was given a hearty vote of thanks.

SUPPLIES AND DEFENSE

By W. D. STARR
THE LEA MANUFACTURING CO.
Waterbury, Conn.

During October two more items important to the Electroplating Industry were placed under priorities control. These are lead and chlorinated solvents. General Preference Order M-38 should be consulted for details on lead. Briefly, we can consider that Defense orders for lead alloy anodes, lead tank linings, etc. will be filled first after which non-defense orders will receive attention consistent with the available supply.

General Preference Order M-41 sets up the control over chlorinated solvents which includes the common degreasing solvents. Defense orders receive first attention and supplies remaining are allotted in definite proportions for non-defense use. Industrial firms having degreasing machines are entitled in any one month to receive for non-defense use one-sixth of the quantity of solvent consumed by them during the six month period ended June 30, 1941. This quota is to be filled after defense requirements are satisfied. Purchaser's certificate on Form PD-127 is required prior to delivery.

Copper Conservation Order M-9-c, effective October 21, contains interesting provisions for copper and copper alloy plating. Decorative plating is out. A copper or brass surface must be necessary to the proper functioning of the article and the article must either have been formerly plated, or if not, the amount of metal used in plating must not exceed 5% of the amount used in making the solid product immediately prior to October 21st. Zinc is said to have eased somewhat and any defense rating is currently securing reasonably prompt delivery. Non-defense zinc supply is slow and uncertain. High ratings are still needed to obtain cadmium but we hear direct from OPM that one distributor at least will have an increased allotment during the next three months which should release material on lower rated, yet urgent orders. Nickel allocation has been extended to March 31, 1942 anticipating a shortage about 50% greater next year than in 1941.

Preference rating Order P-22 has been amended to include Maintenance, Repair, or Operating Supplies for practically all firms doing manufacturing, processing or fabricating. This is said to cover all necessary materials consumed in the course of production but which are not physically incorporated in the product. By this definition many plating and finishing supplies are included. A simple endorsement on a purchase order assigns Rating A-10 to material being procured under the circumstances outlined in Preference Rating Order P-22, amended, a copy of which should be obtained and carefully read before using its provisions.

An OPM order bans the use of bright finish, bright work, metal finish or body trim containing aluminum, copper, nickel or chrome on automobiles after December 15. Production of such parts is being stopped except for amounts needed for cars which will be completed before December 15. Upon application to OPM permission to use the restricted materials on bumpers and bumper guards may be granted.

HOW PRIORITY SYSTEM IS INJURING BUSINESS

(Reprinted from *United States News* September 19, 1941.)

Businessmen today face another paradox of starvation amid plenty. In the depression years, it was a paradox of jobless men amid surpluses of copper, steel, machines. Now it is a paradox of threatened starvation for manufacturers overloaded with orders but unable to get supplies of steel, copper, brass, aluminum, nickel or chemicals. A high priorities rating has become the price of survival for thousands of businessmen. The result is a continuing flood of applications for preference ratings from the Office of Production Management and the Army and Navy. One of the first acts of Donald M. Nelson, new director of priorities, was to sweep through a large accumulation of priority requests. This cleared the way for quick decisions on incoming applications. Despite the vigor of Mr. Nelson's attack on the priorities tangle, apprehension rules in scores of manufacturing communities feeling the increasing shortage of materials. Many manufacturers, near the end of their rope on supplies, have the choice of shifting to defense work in order to get priority on materials or of closing down. It is difficult to plan on substitutes, because the supply problem is moving from one bottleneck to another.

Manufacturers have seen the greatest industrial boom in the nation's business history. Defense orders were piled on top of a civilian scramble for goods. Except for a few metals, there were enough materials to go around. But the boom in non-defense industry is giving way to a priorities crisis. Impending crisis for non-defense manufacturers is pictured in a survey of 6,000 plants just made by the Chamber of Commerce of the United States. The Chamber concluded that nine out of ten small non-defense manufacturers believe they soon will be forced to curtain operations, dismiss thousands of workers or shut down entirely unless something happens to change the outlook.

Distress stories are piling in. An Ohio vacuum cleaner manufacturer turned to steel as a substitute for aluminum. Now he is worried about getting steel, in addition to zinc, chromium and plastics. An Illinois cellophane maker cannot get delivery on machines ordered a year ago. He sees, moreover, a chance that he may have to close unless he can obtain chemicals. Said a Maryland ice refrigerator manufacturer: "We have given up hope of obtaining materials such as copper, brass, stainless steel, aluminum and furniture steel." A maker of building materials reported: "It is hard to buy anything, even ordinary screws, nuts, bolts and other common items which used to be plentiful." In similar vein, studded with forecasts of shutdowns and unemployment, are manufacturers' tales about the difficulty of getting tools, motors, gauges, steel plates, chlorine, plastic molding powder, steel alloys.

Biggest worry of manufacturers is steel. The reason is that steel is the most widely used of all metals. It enters into manufacture of literally thousands of products. Such relatively minor metals as tungsten, nickel, aluminum and magnesium came under priority control last winter and spring. Temporarily, many producers were able to keep going by shifting to steel or simply dispensing with parts made of scarcer metals. When prioity control was extended to pig iron and steel, the meaning of all-out defense production became clear to manufacturers who had felt little inconvenience from restrictions on such materials as neoprene (synthetic rubber) and nickel-bearing alloys. The steel shortage centers in plates, structural shapes and alloys. Outstanding is the bottleneck in plates — caused by demand for ships, tanks, pipe lines and railroad equipment. So heavy is demand for plates that the Supply Priorities and Allocations Board, in its first important decision since it was appointed by President Roosevelt, turned down a proposed 1,800 mile pipe line to carry oil from Texas fields to Eastern refining areas. Steel difficulties illustrate the spreading effects of priorities and shortages. In an attempt to overcome bottlenecks in aluminum, magnesium, rubber and other materials, defense planners started expansion of productive capacity. These projects require steel and other metals for construction of plants and for machines.

Consequently, with every advance of the defense program, there has been widening steel demand, for construction, transportation equipment, machinery. Recognizing this, SPAB also applied the brakes to factory expansion in non-defense industries. First hint of this was postponement of a plan for increase of capacity at Kingsport, Tenn., by Tennessee Eastman Corp., maker of plastics. Numerous public works also face postponement until after the war. Jesse Jones, Federal Loan Administrator, called attention to this policy, in announcing that a proposed Delaware River tunnel must await the postwar period. Steel-making capacity is being readjusted to produce more of the heavy projects required for defense, such as plates. In turn, this creates new difficulties for non-defense manufacturers by diverting ingots from lighter products like sheets, used chiefly in civilian goods. So the defense program evolves — from one bottleneck to another.

Next to steel, the most serious material shortage is rising in copper. For many manufacturers, it will be the greatest bottleneck of all. This is particularly true for makers of electrical goods. Like steel, copper is used in a variety of manufactures and frequently is indispensable. Hence, for lack of a few tons of copper, some manufacturers may be unable to operate. Use of copper is due for a swift increase, in the making of shells, ships and other war equipment. OPM officials forecast defense in the next year or so may take all the copper available.

Shipping scarcity limits the amount which can be brought in from South America. Possibilities of increasing domestic output of copper do not appear bright enough to banish the shortage threat.

At first users of nonferrous metals thought they saw a partial solution in a shift to plastics. But plastics, too, have become a bottleneck because demand outstripped supply. Obstructing expansion of plastics production is a shortage, necessitating priority control, in certain chemicals, and the difficulty of building more plants. From basic materials like steel, copper, zinc, aluminum and rubber, the priorities crisis spreads to products using these essentials. Thus, inability to get copper may bring shortages of electric motors and wire. Farther down the line, this hits factory installations. The chain of shortages becomes endless.

Prospects are that metal shortages will pinch non-defense manufacturers hardest in the next few months. Industry is entering a real period of transition to rapid expansion of arms production. Hence manufacturers unable to get preference ratings or to obtain substitutes for scarce materials must find defense work to keep alive. Now going to bat for the manufacturer who needs Government contracts or sub-contracts is Floyd L. Odlum, Wall Street financier, just appointed head of OPM's Division of Contract Distribution. He has the timely task of putting drive behind the spread-the-work campaign, designed to save smaller producers from closing shop as well as to speed arms output. The Army and Navy are preparing to go along with this effort.

Big industrial concerns, with numerous plants and diversified machinery, are better adapted to quick change-over to defense work than the smaller units. Outstanding examples of the shift to armament jobs are the leading automobile manufacturers. General Motors alone has $1,200,000,000 in war contracts and expects to turn out nearly $700,000,000 of airplanes, guns, motors and other war equipment in the next year. In the automobile industry, effects of curtailment of non-defense production are being tempered by the switch-over to armament work. General Motors, in reducing automobile output, will have to cut regular employment one-third. This means 100,000 men will be laid off or transferred to work on defense contracts. Charles E. Wilson, president of General Motors, contends that accumulation of defense contracts in the hands of "big business" is a logical answer to the size of the defense production job. The big concerns, he argues, have the organization and equipment to turn the work out speedily. But he also sees

a place for the medium and small manufacturer in taking sub-contracts.

Unless defense work is spread more widely, the non-defense segment of industry may experience something new in business history — a priorities depression. The threat is more disturbing to businessmen than in the first World War because this conflict shows signs of becoming a prolonged struggle.

OPM officials are trying to ease the transition by tapering off production of consumer goods. The tapering process has started in automobiles, washing machines, refrigerators and other metal-using goods for the civilian market. But it is difficult to plan the transition so precisely that unemployment and factory shutdowns will be avoided. Besides the men on the assembly lines and at factory work benches, the priorities crisis extends to thousands of dealers selling non-defense products, along with office employes and services dependent upon earnings of factory workers. There is little doubt that priorities are about to become the No. 1 question for most businessmen of the nation. Concern over priorities has been shown in meetings of businessmen in Chicago and Indianapolis. More of these meetings may be expected. Capitol Hill, as Congress reconvenes, probably will hear echoes of rumblings in communities threatened with factory shutdowns. Priorities, in fact, are well on the way to becoming a front-rank national problem.

FIRST INDUSTRY-WIDE REQUEST FOR REDUCTION OF MODELS GOES TO BICYCLE MAKERS

(From *Defense*, August, 1941)

A voluntary program to conserve materials and manpower for national defense by simplification of design, substitution of materials, and a reduction of the number of bicycle models has been requested by the Conservation Bureau of OPM.

In a letter sent to eleven bicycle manufacturers, Robert E. McConnell, chief of the Conservation Bureau, asked producers to adopt the following measures: 1. Reduce the number of models to a maximum of 10 for each manufacturer. The number of models presently being turned out ranges from about 20 to as many as 40. Juvenile and racing models, under this program, probably will be discontinued. 2. Eliminate all chrome, copper, nickel, and metallic finish for decoration. No estimate is available of the possible savings of these materials but it is expected to be considerable. 3. Reduce the average weight per bicycle by 10 percent of the average weight of 1940 models. This will be accomplished largely by the removal of nonessential equipment and decorative trim. 4. Substitute reclaimed rubber for raw rubber wherever possible. 5. Eliminate white sidewall tires. It is estimated that the elimination of white sidewall tires will reduce the consumption of rubber in the bicycle industry by about 20 percent.

This program represents the first direct action by OPM to effect savings throughout an entire industry by reduction of nonessential models. It was discussed at a meeting the previous week between Mr. McConnell and bicycle manufacturers, parts suppliers, and retailers. It was generally agreed that the plan is practicable and would be beneficial not only to the defense program but to the industry. During the World War bicycle models were reduced to three, and such features as fancy bars, stands, truss type forks, and so forth, were eliminated. It was estimated that 2,265 tons of steel were saved by such eliminations and simplification of models. The bicycle industry produced a record number of approximately 1,325,000 bicycles with an approximate value of $25,000,000 during 1940. It is estimated that there are about 10,000,000 bicycles in operation in the country today.

METAL CLEANING

By W. F. SHERMAN
Detroit Editor, The Iron Age

The most successful methods of metal cleaning have always been those which make use of the dissolving action of a reagent or the detergent, wetting, penetrating and dispersing properties of specially compounded cleaning media. There is little reason to believe that these methods, combined with the obvious mechanical scrubbing action, will ever be displaced in industrial plants. However, an entirely new approach to the problem of metal degreasing and cleaning is indicated in claims made for a new patented material recently employed in several industrial plants and offered by Kolene Corp., Detroit, under the name Kolene Kleaner. This cleaner is a bath of catalyzed molten salts.

The action of this cleaner is that of oxidizing all of the various materials on the surface of the metal to be cleaned, the oxidation converting these materials into readily removable compounds. The first action is that of degreasing, which is accomplished by the oxidation of all carbonaceous matter, oils, greases, etc. This degreasing operation is not performed as a separate one, nor is the cleaner designed specifically as a degreaser, but the action on the carbonaceous matter is incidental to the cleaning operation which it accompanies.

The second action, simultaneous with the first, is the conversion of materials on the surface, including mill scale and heat-treat scale, which are relatively insoluble in many cleaners, into very readily soluble materials which can be removed in a mild acid bath. This action is accomplished through application of the well-known fact that the oxide of any metal containing the most oxygen is more soluble than oxides containing less oxygen. In most instances with this cleaner, this is exactly the reaction that takes place. Taking, as an example, magnetic oxide of iron, which is the thick middle layer in mill scale (and highly resistant to attack even by sulphuric acid) the reaction is as follows when the cleaner is applied: $2\ Fe_3O_4 + O \rightarrow 3Fe_2O_3$. The resultant compound is one more readily dissolvable and therefore more easily removed from the metal. A similar reaction is possible with the cupric oxide sometimes found on copper parts: $2\ Cu_2O + O_2 \rightarrow 2\ Cu_2O_2$. The two foregoing examples are instances in which the lower oxides (virtually insoluble) are converted to oxides which are more soluble.

Cleaning Cast Irons

Another aspect in the use of this new cleaner is presented in the cleaning of cast iron surfaces which normally have on them so much silica that plating or coatings of any sort are extremely difficult to apply. In this case the reaction with the cleaning material is to convert the silica to silicon dioxide, which is soluble in the cleaner. The present general practice of acid pickling exposes other materials such as phosphorus, sulphur, carbon and silicon because of the severe action of the acid on the metal itself. Where these are present, the Kolene Kleaner is said to oxidize the phosphorus, sulphur and carbon into vaporizable oxides. In addition to the action on oils and greases, mill scale and silica, etc., the cleaner is said to have a similar action on welding flux and welding scale and makes it possible to remove them readily from the surface of metal parts. Buffing and polishing compounds, sometimes found difficult to remove, are treated in the same way by this new method.

The Kolene mixture of salts is operative between 550 deg. and 600° F., at which temperatures the salts form a clear green liquid. The carbonaceous materials oxidized by this liquid in the degreasing stage are all converted into vaporizable oxides which pass off as carbon dioxide without contaminating the bath. Hydrogen freed during some of the reaction passes off as steam. It is stated that the other materials being cleaned from the metal are converted into extremely soluble oxides and are removed by short mild acid pickle. The degreasing action is complete as evidenced by the absence of water break on the cleaned metal.

Where it is necessary under present conditions to pickle for a considerable

time in acid to remove impurities which are relatively insoluble, the base metal is also attacked, exposing insoluble materials from the metal itself which show up on the surface as black smudge, commonly known as pickling smudge. The new cleaning method makes long pickling unnecessary, so it does not produce pickling smudge. When necessary it will even remove smudge from over-pickled pieces.

No Hydrogen Embrittlement

Another feature is the absence of hydrogen embrittlement on springs and similar parts which acid pickling sometimes produces, due to the release of hydrogen during the pickling action. The absence of hydrogen embrittlement after use of this cleaner is attributed to the short time required in the acid vat. Lock washers are among the parts which are being cleaned with this method and tests of 100 hr. in salt spray and on compression testing machines have been accomplished without failure of the metal. Because the cleaner so readily provides for the quick removal of all types of buffing compounds, the less soluble compounds (sometimes lower in cost) can be used when desired.

Besides the evidence of complete cleaning given by the absence of water break, a practical proof is offered in the readiness with which metal so cleaned can be coated with very low tin alloys, compositions with as high as 90 per cent lead having been used with remarkable success. This cleaning provides a means of improving other finishes such as galvanizing, cadmium, paint, etc. Pots made of carbon steel or boiler plate in any desired shape are used for the operation. Heating by any conventional means can be employed and in most cases the pots are sheathed and insulated against loss of heat. Vents are usually provided above the pots to carry off excessive fumes from the impurities, such as oil and grease, but the fumes are said to be non-toxic and non-corrosive.

The compounds formed by the cleaner (without any subsequent acid pickling bath) may be employed as a paint base. Such compounds, being of the highest possible oxygen content, cannot oxidize further and therefore, are themselves fairly resistant coatings. At the same time, the oxidizing effects of the bath make it a suitable paint remover.

A typical application, illustrative of effectiveness and time saving is welded pipe. Mill scale on welded pipe and the line of welding flux around the seams has been a problem in the pipe industry. Cleaning has frequently been accomplished with an alkaline wash for 5 min., followed by a rinse, 2-hr. pickle in inhibited sulphuric-hydrofluoric acid (10 per cent at 180 deg. F.), then a second rinse, an alkaline neutralizer bath and a third rinse; total time 125 min. The Kolene procedure calls for only 10-min. immersion, rinse, 15 min. in the cleaner, then rinse, and ½ min. in acid again; total time 30½ min. In addition, the Kolene procedure cuts out a degreasing operation which becomes unnecessary. The original process for iron castings calls for sand blast, followed by pickling for 18 to 24 hr. in sulphuric-hydrofluoric acid. The Kolene process has been set up for 5-min. immersion in the Kolene Kleaner, treatment with the same acid as above for 15 min., reimmersion in Kolene for 20 min. and a 15-sec. (approximately) dip in hydrochloric acid. The material described in this article is a new cleaner not similar to the Kolene chlorinated solvent previously on the market and still used for some applications.

NEW USE FOR COTTON INDUSTRIAL BAGS

The Yale and Towne Manufacturing Company has developed a new use for cotton industrial bags: to group sub-assemblies which are sent to the main assembly lines. Related parts for assembly of electric industrial trucks and tractors, including lock washers, nuts, cotter pins, lugs, fittings and light machinery parts, are placed in a bag or small group of bags in the stockroom. The paper tag sewed into the bottom seam of the bag is marked for quick identification. As the trucks and tractors move down the assembly line to the point where these parts will be needed, the bags of parts are sent out to the line. Considerable time and labor are saved on the assembly floor because all parts sent in bags are readily accessible.

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Business and Social News

BRANCH NEWS

Educational Activities

AMERICAN ELECTROPLATERS' SOCIETY

Boston Branch met Thursday, Oct. 2, at the Statler Hotel with President Jones in the chair. Ernest D. Callahan, 34 Marshall Ave., Malden Mass., was elected to active membership.

Joe Barron made his report of the convention and it was a great success. The report was accepted by the Branch and a rising vote of thanks was given him for the great work he did to make it the greatest ever held. The picture of the convention will be shown at the next meeting and all the members and their wives are welcome to see it.

Boston Branch will follow the Society slogan and conduct a chemistry class this year. This class will meet Thursday evenings at 7:30 P.M. in room 8-319 at the Massachusetts Institute of Technology at Cambridge, Mass. The first part will be an informal discussion of elementary chemistry and its relation to plating; the following parts will be more advanced, covering the field generally classed as electrochemistry. The first meeting will be Thursday, Oct. 9, 1941. This class is open to all platers. You can register with George Swift or Louis Gagnon at M.I.T. Thursday evening. George P. Swift, Instructor in Metallurgy, at M.I.T. will be the instructor.

A general discussion by the Librarian on black nickel, tin, zinc, and cadmium solutions, went on for more than an hour.

A. W. GARRETT, *Secy.*

Bridgeport Branch held its regular monthly meeting Thursday, October 2, at 8:00 P.M. at the Stratfield Hotel. President John E. Charleson opened the meeting. We had with us our friend, Mr. Jack English of the New Haven Branch.

Herman Braun of the Outing Committee reported a successful outing and a good time was had by all who attended the outing held at William Ehrencrona's estate in Trumbull, September 13.

A report of the Regional Meeting was given by the secretary, indicating that a profit was made from this meeting and that checks would be sent out in the near future to all branches concerned.

Letter from New Haven Branch inviting members of our Branch to attend their Educational Sessions and lectures. Truly, this is a fine invitation and our members should take advantage of it.

Richard T. Haubrich of the Bridgeport Brass Co., Bridgeport, Conn., applied for active membership. Mr. Elton V. Buckley transferred from the Boston Branch to the Bridgeport Branch and was introduced to the Branch by President Charleston.

President Charleson turned the meeting over to Dr. Walter R. Meyer, substituting for C. C. Helmle, who was away on a trip west. Dr. Meyer did a very good job of Educational Chairman, giving us briefs and facts on various problems of the plating industry which proved very interesting.

JOSEPH G. STERLING, *Secy.*

Binghamton-Syracuse Branch held its regular monthly meeting at the Hotel Cortland, Friday evening, September 26. After dinner the meet-

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ing was called to order by President William Mahar. After a few remarks by the president our Librarian, Mr. Harry Herlikofer, introduced the guest speaker, Mr. D. S. Hartshorn, Jr., Technical Director of the Enthone Co., New Haven, Conn.

Mr. Hartshorn gave a very interesting talk on "Wetting Agents and their Application in the Finishing Industry." Judging from the number of questions asked I am sure everyone received something out of this meeting.

We received an application from Duane Lawton of the Pass & Seymour Co. of Solvay as associate member of our Branch. Due to a Branch being formed in Syracuse our Branch name will be changed to Binghamton Branch.

F. W. KENYON, *Secy.*

St. Louis Branch held its regular monthly meeting at the Central Branch Y.M.C.A. Dinner was served to 18 members. A letter was read from Mr. Caldwell in regard to an election of a second vice-president who in turn would be chairman of the membership drive.

Mr. E. J. Musick made a report on the summer picnic and stated everyone had a good time. It was suggested that we hold our picnic next year in September as the weather is cooler at that time. At the picnic Mr. B. G. Daw showed pictures that he had taken at the last year's picnic. They were very good.

It was suggested that we hold our meetings on the First Monday of each month, after a little discussion a motion was made and seconded that we hold meetings on Monday for two months to give it a trial. Motion carried and secretary instructed to send out cards to members to get their opinions.

Mr. Vogt being absent, the president asked for suggestions as to what to put on at our next meeting. Stated that he could get pictures. Was suggested that at each meeting a member of the branch give a short talk, suggestions well taken. Two applications were received, Mr. Otto Dingeldein and Mr. Norman House. Applications turned were over to board of managers. Mr. C. A. Schmidt resigned.

CHAS. T. MCGINLEY, *Secy.*

Chicago Branch held its regular montly meeting at the Atlantic Hotel, President C. Kelly presiding. Mr. F. G. Berquist was elected as an associate member of Chicago branch.

Mr. H. A. Gilbertson chairman of the Annual Educational Session and Banquet reported that same will be held the fourth Saturday in January, 1942, at the Palmer House and that plans

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are being made to have this one of the best annual sessions ever held by Chicago branch both from an Educational and Banquet standpoint. All A.E.S. members should keep this date in mind.

Mr. E. Woodmansee, the librarian, presented the speaker of the evening, Mr. J. M. Cosgrove of the Bruce Products Corp. who spoke on "Plating Tank Ventilation" This subject proved very interesting. Mr. Cosgrove offered to mail a copy of his paper to any member wishing it.

J. W. HANLON, *Secy.*

Detroit Branch held its regular monthly meeting Friday, October 10 at 8:15 P.M. at the Hotel Statler with President Pinner presiding. After the routine business of the meeting was taken care of a moving picture "The Making and Shaping of Steel" was shown, through the courtesy of the United States Steel Corporation. This picture was thoroughly enjoyed by the members as it showed the steps in steel making from blasting the ore to the finished sheets and structural shapes used in industry.

Talks and discussions on Copper Oxide Rectifiers were given jointly by Mr. R. B. Paine and Mr. I. A. Lee, both of General Electric Company. An open discussion of the subject by the group followed.

The Question Box is still popular and was ably handled by Librarian Hahn with the assistance of the Board of Experts composed of Messrs. Paine, Lee, Hoefer, Phillips and Spencer. The meeting was well attended by approximately 175 persons.

WARREN I. GRIMMER, *Secy.*

Toledo Branch held its regular monthly meeting at the Macomber high school lab. rooms, Friday, Sept. 12, 8:00 o'clock, with 15 members present, President Vannorsdall presiding.

Minutes of the previous meeting were approved after one correction, that Toledo branch will not lose Harry E. Moser as a member, because he took a position in Detroit; the correction was made by Mr. Moser.

The election of a second vice-president to act as chairman of the exhibits committee was postponed until the next regular meeting. Mr. Dressell, chairman of the educational committee, gave a report on the progress of his committee, he also announced that for the next regular meeting he expected to have Mr. Milikan of Cleveland (with the OPM) as the guest speaker. An announcement concerning the Detroit banquet to be held in December was made, and everyone present

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received a slip to make out if they wished to go.

At this time the meeting was turned over to Dr. M. M. Beckwith of the J. B. Ford Co. who spoke on the subject "Chrome Contamination in Alkali Sol." The subject proved to be so interesting that it was discussed by the speaker and the members for a full hour after his talk was over.

GASTON BERGEMAN, *Secy.*

Rochester Branch held its September meeting on Friday, September 19. The meeting was an open meeting with discussion of plans for the 1941-42 season. The educational chairman, Mr. Phillip LoPresti reported plans for a very full program starting with the October meeting. These plans had not been completely formulated with the exception of the October meeting. This meeting is to be held on Friday October 17 and is to be a Board of Experts with discussion by everyone. We are to hold this in conjunction with a Fish Fry. Plans were also discussed for an Annual Meeting to be held on the 3rd Saturday in April or April 18, 1942. It was decided to start action on this at once. The request of Harry Bernard for transfer to the New York Branch was then read and ordered carried out. After a little more discussion of plans for the Clambake on Saturday October 4, the meeting was adjourned.

JUDSON R. ELSTER, *Secy.*

Toronto Branch held its regular monthly meeting on October 3, at the King Edward Hotel. President Jim Graham opened the meeting with a good attendance and gave his salutations to Harry Cresswell and Archie Smith. Five applications were received for membership. Mr. Charles Jack Emberley, Mr. Rodger J. Atkinson, Mr. Samuel McKee, and Mr. George G. Harris, were elected into membership.

Allan Byers read the report of the executive meeting about the branch library. President Graham urged the members to find out what new books were the best as new additions for our library; and Bill Price gave report of the books in his possession at the present time. Mr. John Acheson was elected to see the Hotel management about a permanent position for our bookcase.

J. S. Cairns gave a talk on water break elimination, showing samples of skates and taking as his theme the statement by John Acheson a few weeks ago that "although a piece of metal showed no water breaks that is no indication the metal is clean." In the discussion, mention was made of cleaner operations acid dips, warm sulphuric pickles, and wetting agents.

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Mr. Acheson backed up his statements with a review of his past experiments along the line of perfect cleaning for perfect adhesion of the electroplate.

J. S. CAIRNS

Buffalo Branch held its regular monthly meeting at the Bailey Bowling Academy, Friday, October 11. President Joe Ruff called the meeting to order. The recent clambake held by Rochester at which Buffalo was strongly represented was the subject of much favorable comment. Incidentally Buffalo has regained the coveted trophy which is now in the proud possession of Joe Ruff awaiting a suitable inscription.

Dr. Wernlund, speaker of the evening, gave a brief but interesting summary of papers read at the Convention. The subject of the various substitutions necessary in plating because of the Defense Program evoked a very good discussion. With his wide knowledge of both practical and technical matters, Dr. Wernlund was able to answer the usual questions and this provided a very interesting and informative evening. He was given a hearty vote of thanks and the meeting adjourned at 11 o'clock.

RHODERICK MCGHEE, *Secy.*

Anderson Branch held its October dinner meeting at 7:00 P.M., Monday October 6, at the Anderson Y. M. C.A., President Oyler presiding.

Dr. A. Kenneth Graham, consultant for the McGean Chemical Co. was the speaker. His subject was "Factors Affecting Roughness in Rochelle Copper Baths." His presentation shed an interesting light on details that are frequently overlooked or not considered as affecting roughness. A lengthy informative discussion followed. In a short business session Mr. A. S. Byrum was elected to associate membership.

E. L. MCKINNEY, *Secy.*

Baltimore-Washington Branch opened the fall season with a business meeting and plant visitation at the Bureau of Engraving and Printing, Washington, D.C., on Friday evening, Oct. 10. A group of forty members and guests enjoyed an interesting session. Our excellent start in the new membership campaign was helped no little by the receipt of six new applications for membership, and three previous applicants were duly elected as branch members. Our energetic committee of Messrs. Sam Warnock and Ken Huston were warmly congratulated. Congratulations were also extended to our newly elevated member, Tom Slattery, who, as assistant director of the Bureau of Engraving and

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It was voted to hold our November meeting in Baltimore on Nov. 8 to avoid conflict with the annual meeting of the Philadelphia Branch, for which their Mr. George Gehling extended us a hearty invitation.

After the meeting, the electrolytic plate-making process was viewed in operation with much interest. This is an electroforming process using heavy deposits of nickel and iron to reproduce the intaglio printing designs engraved in steel, which are used in printing currency and bonds for the government. Chromium plating is also used.

C. T. THOMAS, *Secy.*

Newark Branch held its regular monthly meeting on Friday evening, October 3, at the Hotel Robert Treat in Newark, N. J. The meeting was called to order at 8:30 P.M. by Vice-President William Bruhns. Other officers present were Robert R. Sizelove, 2nd Vice-Pres.; George Wagner, Secy.-Treas.; Roy Stout, Serg.-at-arms; Horace H. Smith, John B. Kotches and Paul A. Oldam, Board of Managers.

Mr. Horace Smith reported that the date for our annual Christmas Party is December 13th and that the Ballroom of the Robert Treat was engaged for this party. He asked the members to cooperate with the committee by selling as many chance books as possible, stating that this would enable us to give this party at the cost of only $1.00 per member. The question of bringing a friend to this party for the same admission charge was brought up and it was pointed out that inasmuch as the party would cost about $3.00 per person and that any amount of outsiders might come the matter would need some serious consideration and was left open to be decided at some future time or by the committee.

Mr. Paul A. Oldam, librarian protem., presented the speaker for the evening, our own friend and fellow member Everett Ward whose subject was "Priorities." Mr. Ward's paper was the first of a series of papers to be presented during the fall and winter meetings. It dealt mostly with priorities and substitutions for metals needed for National Defense. This paper will be sent to the MONTHLY REVIEW for publication. Mr. Ward was given a rising vote of thanks by the 41 members who attended. Mr. Oldam conducted a Question Box.

GEORGE WAGNER, *Secy.*

Los Angeles Branch. The October meeting was opened with a thunderous

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burst of applause for our President and Vice-President, whose smiling faces again beamed on us from their accustomed places for the first time since our summer vacation. The minutes of the previous meeting were read and amended to acknowledge our appreciation to Tony Vasquez for his courtesy in providing the film shown at that meeting.

The full text of Mr. Lamoureux's letter of appreciation was read and the letter placed on file. Mr. Rushton read a letter from Mr. Hanlon telling of the illness of Mr. Oscar Servis. It was ordered that the Secretary send a letter of encouragement to Mr. Servis. The Committee on the Ladies Auxiliary reported and started a discussion on how interest might best be encouraged among the wives of the Branch members in the Auxiliary, and also how the interest of the members might be promoted in our Branch meetings.

It was moved and carried that the president appoint a Program committee of which the librarian shall be chairman. Those appointed to the committee are Emmett Holman, President, Earl Coffin, and Frank Rushton. Oscar Gast, and Jim ApRoberts were appointed to assist them. It was ordered that this committee shall meet once a month to outline a program for the regular branch meetings.

A moving picture showing the electrocoating of sandpaper was shown by Behr-Maning Division of the Norton Company. Mr. Wiswell of the Behr-Maning Company explained the various steps in the process as they were shown in the film. After the picture there was a discussion of belt polishing machines. A moving picture of the Gilmore Oil Company Grand Canyon Economy Driving Contest was screened.

The meeting was then turned over

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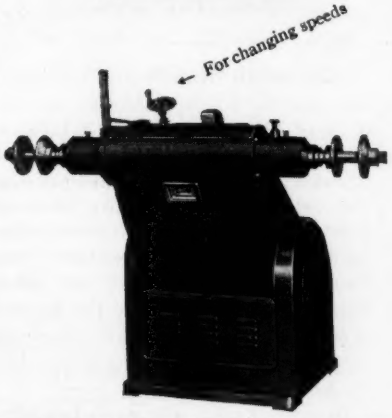

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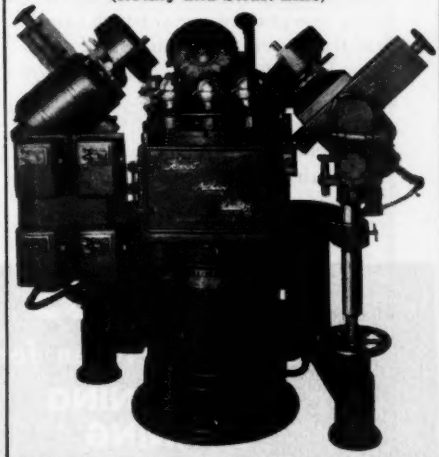

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to the librarian for the Question Box Period. After some lively discussion of defense work in plating shops the meeting was adjourned.

ERVIN FRAUENHOFF, *Secy.*

Pittsburgh Branch held its second fall meeting Friday, October 10, instead of Thursday, October 2, because of the Electrochemical Meeting in Chicago on that date. The meeting was held at the University Club at 8:30. Dr. C. L. Faust of Battelle Institute was our guest speaker. Dr. Faust presented a paper on Alloy Plating, in which he gave the history of alloy plating, the general principles involved, and some specific alloys that are being plated today.

In general alloy plating is brighter, denser, more corrosion resistant, and frequently operated at higher current efficiency than single metal plating. Alloy plating is a method of getting a very fine grained metal which can be heat treated to obtain increased grain size. For the above reason alloy plating is more applicable to the engineering field than the decorative finish field.

With the phase diagram of the desired alloy and the plating solution characteristics of the various metals involved as a starting point, research on alloy plating must be carried on to find the best bath, the characteristics of that bath, and the effect of various conditions on that bath. To determine if and how the bath changes with working, a life study is usually based on 100 ampere hours per liter of solution.

FRANK KELLER, *Secy.*

Springfield Branch held its September meeting at the Hotel Charles on the twenty-second at 8:00 P.M. The meeting was called to order by President Wood. The minutes of the previous meeting were read and approved. Applications for the following candidates for membership were read: Mr. Emil Bonanate and Joseph Guitian of Pittsfield, and Capt. Herbert Gronski and Frank Drake of Watervliet, New York.

Mr. Kennedy explained the attempt which is being made by representatives of the Electroplaters' Society to allocate metals and metal salts to platers and plating establishments which are in desperate need of these materials. The committee met in

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Washington with members of the OPM.

Mr. Kennedy also announced that our friend Tom Slattery has been appointed to the position of Assistant Director of the Bureau of Printing and Engraving. We were all happy to hear of Tom's good fortune.

The president then introduced Mr. Tom Wilber of the Bullard Dunn division of the Bullard Co., who gave us an interesting talk on the Bullard Dunn Process. Mr. Wilber illustrated his talk with samples. The talk was both informative and interesting. Many of us learned a lot about this phase of electrolytic descaling that we had never heard of before.

It was decided by our brothers from Pittsfield, Mass., that they would like to sponsor a meeting in their home town. What could we say, in view of the fact that about half a dozen of them are regular visitors to Springfield regardless of what the weather might be. So be it, our next meeting will be held in Pittsfield, Mass.

D. S. HARTSHORN, JR., *Secy.*

Cleveland Branch held its meeting October 4, at Hotel Cleveland, Cleveland, Ohio. The meeting was called to order at 8:30 P.M. by President P. R. Lyons with an attendance of 36.

The following men were elected by acclamation: Charles J. Foley, of The Accurate Plating Co., active membership; George H. Carter, Oakite Products Co., associate; Henry Bloser, Metal Finishers, Inc., active member-

Fifth Annual

EDUCATIONAL SESSION
and
DINNER DANCE

DETROIT BRANCH, A. E. S.

SATURDAY, DEC. 6, 1941 — STATLER HOTEL, DETROIT

EDUCATIONAL SESSION . . 2:00 P. M.
DINNER DANCE . . . . . 7:00 P. M.

SPEAKERS

W. J. CAMERON, Ford Motor Company
DR. SAMUEL STRATTON, OPM, Washington, D. C.
B. E. LEWIS, Detroit

ship. A letter was read from the Dayton Branch in reference to a regional meeting to be held some time in November.

The speaker, Mr. R. Rimbach, was introduced by the secretary. Mr. Rimbach was born in New York City, is a 1918 graduate of M.I.T., participated in the World War, and is now a consulting engineer for the Standard Steel Spring Co. at Coraopolis, Pa., in charge of the Research Laboratory. He also publishes a technical paper *Instruments*.

Mr. Rimbach was ably assisted by Mr. McQuilken his laboratory assistant, who worked the slide projector.

Corronizing is playing a more and more important role in protective coating. One of the important materials being coated is fly screen for a large mail order house and the department is in the charge of one of our Cleveland members Carl Shoemaker of Hanover, Pa. Carl was formerly with the Standard Steel Spring Co. and formerly with The Youngstown Sheet & Tube Co. Mr. Rimbach stated that in the corronizing method, a saving was made of zinc over hot dip galvanizing which is quite important under present conditions. Bending, forming, and welding do not affect the corrosion resistance quality of the coating.

This new coating appears to have a widespread application in many fields. As a metallic protection to ordinary low-carbon steels, it permits their use in all types of fabrications exposed to weather as well as to corrosive action of acid vapors and various solutions. As a low-cost, highly protective coating, the material is expected to find wide application where corrosion problems are encountered. The coating may be designed to give the exact amount of protection required in each case. It is also used in dairy equipment where there is a high corrosive action on account of equipment disinfectants used.

After a question and answer period, the meeting adjourned with a rising vote of thanks to both the speaker Mr. Rimbach and his assistant Mr. McQuilken.

FRANK J. OPATRNY, *Secy.*

Waterbury Branch held its second meeting of the season on October 10, at the Hotel Elton. At 8:00 P.M. President Colter opened the meeting. The final report from Apley Austin on the Third Annual Regional Meeting was read. This report indicated a net profit of $161.21 after all expenses were paid. Waterbury's share in this is $32.24.

Announcement was made of the New Haven Branch educational program. This year it will consist of a course of lectures, held bi-monthly at Sterling Chemistry Laboratory on Substitution of Materials, Methods of Manufacture and Finishes due to the Defense Program. Details may be obtained by contacting the secretary of the New Haven Branch.

The election, at the business meeting on September 29 of Roy Anderson, Walter Ruefli, Jacob Hyner, and Emile Beloin was announced, and an application from Stuart E. Judd of the Mattatuck Mfg. Co. was read. Booklets covering Specifications for Electrodeposited Coatings were distributed to the members.

Everyone was pleased to have Bill Kennedy with us again and we hope he will be able to get down more often this season. He informed us that the proceedings of the Boston Convention would be ready almost immediately,

in fact they were promised for Monday. A new Branch, the 32nd to be formed, has been established at Syracuse and should promote increased interest in the society in this territory. The Electrochemical Meeting which this time featured electroplating was well attended by the platers. It was Bill Kennedy's opinion that the meeting was very successful and the book to be published, based on the papers, should be well worth having.

Ellsworth Candee reported on the relation of electroplating to defense and advised us that the OPM was forming a committee to consider the problems of electroplating. Officers of the A.E.S. will be included on the committee. Thus giving the platers themselves a voice in the proceedings. George Dubpernell reviewed the preprints on electroplating read at the Electrochemical Society meeting. His opinion coincides with that of Bill Kennedy's, that they will make a very valuable contribution to plating literature when published in book form.

Bill Starr, technical chairman for the evening introduced Mr. Gordon J. Berry of Electric Products Co. and Mr. I. R. Smith of Westinghouse Electric and Mfg. Co. These gentlemen very ably presented the advantages and disadvantages of Rectifiers and motor generators. All of us should have a much clearer understanding of how these machines can best be applied to our particular problems.

S. L. HENN, *Secy.*

Dayton Branch held its regular meeting at the Engineers Club on Friday October 10. Mr. Russell Holland was elected second vice-president to head the membership campaign. The members showed their willingness to cooperate by bringing in the following applications for membership: Mr. E. L. Luaces, Mr. Arthur German, Mr. R. H. Tate of Dayton, Mr. Charles L. Faust of Columbus, Mr. M. C. Jewett, Mr. Werner Bensman, and Mr. Herman Baker of Sidney. Arrangements are being made by a group from the Dayton Branch to attend the Detroit meeting on Dec. 6th.

A letter was received by Mr. Thompson, from Toledo, declining to attempt a regional meeting with Dayton and Cleveland this year. After hearing this letter read, some of the members thought that it would be possible to interest Cincinnati, Anderson and Indianapolis in a meeting of this kind Mr. Thompson was asked to investigate this.

Two films were shown at this meeting. One was the picture that was taken at the Dayton Convention in 1940 and the Boston Convention this year. This picture is soon to be released to the different Branches and will no doubt be enjoyed very much, especially by those who were present at the time it was taken. The other was the first of three films that Mr. Thompson has made arrangements for with the U. S. Bureau of Mines. This one was the story of Sulphur, from the

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mine to the finished product. These pictures will provide an interesting addition to the educational program.

The feature of the evening was the discussion of plating and business in general in Soviet Russia. Mr. Thompson introduced Mr. W. B. Stoddard of Hamilton, recently returned from several years in Russia as plating Technologist for the Russian Government. With the present state of things in Europe, this discussion, coming from one in such close touch with Russian Industry, could not have been more appropriate.

CORLISS POWELL, *Secy.*

Grand Rapids Branch held its meeting October 10 in the Wolverine Room of the Rowe Hotel. The meeting was opened at eight o'clock by President Maurice Caldwell. Four new members were elected, Louis J. Przybylski, Clifford E. Crouch, Owen Guthrie, and William E. Fryover.

The report of Committees on the banquet which is to be held January 17th were given as well as report of Chairman C. W. Smith on the Convention next June. We had two applications for membership.

Mr. Ivan Hepfer introduced the speaker, Mr. Frank Savage, who gave us a talk on "Automatic Silver Plating." His talk was followed by motion pictures showing automatic silver plating of band instruments. Mr. Savage also explained the different racking features of the equipment and described the equipment and manner of plating of the various instruments.

The Question Box was again conducted by librarian Mr. Sperry. Questions were answered by three members appointed by Mr. Caldwell who provided the answers and round table discussion. The meeting was then adjourned. C. E. ABEL, *Secy.*

Indianapolis Branch October 8th meeting was opened by Pres. Geo. Fisher, who introduced several visitors: J. M. Cosgrove, Fred Atkinson, R. M. Wagner, and Rex W. Oyler (the last two being from the Anderson branch). In the absence of Mr. Bass, the Secretary's report was read by David N. Ross and accepted. W. Cothran, our librarian explained the plan for the year's activity; namely, the idea of combining a short talk by someone in the immediate vicinity followed by an open forum discussion for half the meetings, and securing a nationally known speaker for alternate meetings.

Mr. Ed. L. Buell, foreman of the Record Plant of the Indianapolis Division of R. C. A. spoke briefly and in an interesting manner about the role of "Copper, Nickel, and Chromium plating in the Manufacture of Phonograph Record Dies." The comprehensive outline of the process is given as follows:

1. Making the wax matrix by coating a brass plate with 0.020″ of flowed wax (principally beeswax).
2. Cutting the record in the wax on a recording machine.
3. Metalizing the wax matrix with gold sputtering in a vacuum chamber.
4. Wax disc is then copper plated 0.010″ thick, and the copper is stripped from the wax.
5. Copper disc is cleaned, polished with fine rouge and a soft brush, and nickel plated for one hour.
6. The thin nickel-plated disc is now sweated to a heavy copper plate to form what is known as the Master Matrix.
7. The Master is etched in a stripping solution (cathodic potassium dichromate).
8. The Master is then copper plated, and the copper plate is stripped

from it. This process is repeated as many times as is necessary to produce sufficient dies.

9. The copper disc is cleaned and nickel plated as was the Master.
10. The nickel disc is chromium plated twenty minutes.
11. This disc or die is sweated to a steel plate to form the actual record die.
12. The die is placed in a press (actually two dies to a press to form two sides of the record) and the record is made by pressing the record blank of a plastic resin between the two dies at 1700 lbs./sq. in. pressure and 300 degrees F. The life of a single die is 1,000 records.

Before the OPEN FORUM was announced, Mr. W. R. Binai spoke briefly introducing Mr. Wagner, of the Anderson Branch. Mr. Binai suggested that the Anderson and Indianapolis branches cooperate in giving members notice of both meetings so that those interested might attend.

EZRA A. BLOUNT, *Secy. Protem*

Hartford Branch held its meeting at the Trade School in New Britain, Conn. October 20. Mr. George Hogaboom, of the Hanson-Van Winkle-Munning Co., was the speaker of the evening. His topic was "Questions and Answers." For about one half of the evening he spoke briefly regarding some of the newer applications in the electroplating field. The electroplating of tin on sheet steel, one side only in order to conserve our supply of tin, was described showing the tremendous speed of the continuous strip and the current density used. Plating with a tin and copper alloy, to help conserve the nickel supply, was described and difficulties overcome by using separate anode rods and generators for each element in the alloy. This alloy was described as having a high lustre, high corrosive resistance and easy to plate with chrome. Copper and zinc in brass plate can be handled this same way and at the same time overcoming some of the difficulties with this alloy plate.

The remainder of the evening was used in answering written questions from the audience. The writer was much surprised at the number of written questions submitted to the speaker. I think this speaks well of our speaker and his experience and ability in the electroplating field. One question was for a quick test for the thickness of copper plate for carburizing. If Nitric Acid 1-1 dilution is used and applied with a dropper, one drop, and allowed to stand for 9 seconds rinsed and dried, each 9 second application will represent .0001 inches copper if the original plate is at least .0005 inches thick. This meeting was not finished until 10:15 P.M. and no uneasiness was noted in the highly pleased audience.

Mr. George Meadows and Stanley Rutkowski were elected to associate membership. Four applications were received. Mr. Philip Nigro, Clarence S. Rosenbeck, James F. Burns and Leonard Ravich. Mr. Burns is the

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proprietor of the Hartford Plating Co. and is coming back into the society's membership after quite a long absence. His plating experience is listed as 50 years and this must put him in a class with some of the most experienced platers in the organization.

APLEY N. AUSTIN, *Secy.*

Hartford Branch held its September meeting at the Elks Club, Bristol, Conn. Tom Wilber of the Bullard-Dunn Process Division of the Bullard Company, Bridgeport, Conn., was the speaker of the evening. The Bullard Dunn Process and some of the newer applications was the subject for the evening.

The process is divided into three stages: (1) Cleaning of the work. Use any of the known methods, degreasing, alkaline cleaning, and electro-cleaning.

(2) Removal of oxides. Use the work as the cathode, 10% solution of sulfuric acid, about .1 oz gal. tin metal and a little glue or enthone addition agent. Use Silicon Iron anodes or "Duriron" along with enough tin anodes to maintain the proper tin content. In the regular size tank two tin anodes are sufficient. The Duriron maintains the iron in the ferrous state. 30-80 Amps. sq. ft. are used for the current. Both higher amperage and higher heat will decrease the time for the process. This process is not economical for very heavy deposits of scale such as forging scale but heat treating scale responds very nicely to the treatment.

(3) As this process forms a thin tin plate as soon as the steel is cleaned of scale, the tin plate must be stripped off before most of the preceding operations. This is accomplished by using a reverse current strip in an alkaline cleaner at about 40-60 amps/sq. ft. only a few seconds are usually required.

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Polishing operations can be materially saved if this process is used for descaling. Work that has to be absolutely cleaned can be put through this process. Carbon smut can be removed and steel to be soldered can be improved by leaving the tin plate on. The tin plate helps to give a better bond for painting operations.

Mr. Wilber was given a hearty applause for his fine talk. About 45 members and friends were present and all enjoyed a hand-out lunch afterwards. Our branch's share in the profits of the last two regional conventions is being used to provide the lunches after the meetings in Bristol. Can anyone suggest a better way to spend this money? Antonio Dascoli

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was elected an active member and applications from Geo. Meadows of the Royal Typewriter and Stanley Rutkowski of the Turner & Seymour Mfg. Co. of Torrington were received. A. J. Maynard was elected as a Vice-President and Chairman of the Membership Committee at a previous business session of the branch.

APLEY N. AUSTIN, *Secy.*

Rochester Branch. On Saturday October 4, the Rochester Branch held its Annual Clambake at the Wishing Well. Although it was a typical rainy Platers day, a goodly group of some 150 people attended, including about 30 from our neighboring branch at Buffalo. The baseball game was played between showers with Buffalo getting all the breaks and so winning the game with the score of something like 17 to 9. Thus Buffalo gets the second leg on the Buffalo Trophy. But we'll be in there next summer to get the third and deciding leg. After the ball game, races were run off for both young and old, after which the Bake was served and it certainly was a grand Bake with nothing left to be desired. The committee in charge headed by Bill Treadwell really deserves a big hand for a well planned and executed party. We wish also at this time to express our appreciation to all who aided in making this party a success, with either their assistance or donations.

On October 24 the Rochester Branch held its meeting at the Rochester Turn Verein. It was a combination Fish Fry and regular monthly meeting. The meeting was well attended with about 35 members present. After an excellent meal the meeting was called to order by President John Adams. The following applications were then read and ordered published: David H. Penn, associate, Hilton, N. Y., Michael Andrews, associate, 215 Bernard St., Rochester, N. Y., Arthur Alvon Chambers, associate, 220 Peart Ave., Pt. Pleasant, N. Y. The President then introduced Mr. LoPresti, chairman of the Educational committee. As this was to be a Question and Answer Session Mr. LoPresti then introduced the Answer Board of Mr. Charles Hendershott, Wm. Tucker, John Adams and Judd Elster. After the questions a general discussion took place. We had the pleasure of having Gerry Lux as our guest at this meeting. It was decided to hold our November meeting as a Dinner and general meeting.

JUDSON R. ELSTER, *Secy.*

Syracuse Branch. The embryonic Syracuse Branch of the A.E.S. held its first regular meeting at Syracuse University Chemistry Building, October 10.

About 25 attended and the speaker was Dr. Beckwith of the J. B. Ford Sales Co. We certainly owe Dr. Beckwith more than we gave him for this effort on his part. He gave us a splendid talk on his specialty, "Chromium Contaminations." We are hoping that Dr. Beckwith will be able to come again when we can at least give him a dinner to show our appreciation.

Our thanks also to the University for their cooperation in letting us have the use of Bowne Hall and its facilities.

The learned discussion between the speaker and Dr. Murphy of the University faculty (something about ous and ic) certainly gave this plater the impression that plating must be an art.

This branch should become a good one and a credit to the A.E.S.

GEORGE SIMMONS, *Secy.*

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The Abstract Section

CHARLES C. CONLEY, *Chairman, Program and Educational Committee*

Anodic Coatings on Aluminum. By JUNIUS D. EDWARDS and FRED KELLER. *London Metal Industry* of July 25, 1941. This article discusses solutions used for anodic coatings, namely, sulphuric acid bath and chromic acid bath and the difference in their operations. Coatings produced with sulphuric acid electrotype are several times as thick as those obtained from chromic acid baths. In both cases, it has been shown that the use of a low purity aluminum has more loss of metal than the pure aluminum used. Tables showing comparisons of baths, of alloys used, thickness of coating, current density, and metals removed are given on pages 58, 59, and 60.

ROBERT B. GOODSELL

Insulating Film on Aluminum. BY BRITISH ALUMINUM CO., LTD. and J. T. RICHMOND. *London Metal Industry.* A comparatively thick film of aluminum oxide or hydroxide is provided, having high corrosion resistance, resistance to heat, and effective electrical insulation. The aluminum or aluminum alloy, for example, in the form of tape or wire, is subjected to the action of an aqueous alkaline solution under autoclave conditions at pressures between 40 and 90 lb. per square inch, the temperatures being those of saturated steam corresponding to those pressures. The alkaline solution may contain 4 percent anhydrous sodium carbonate, 4 percent crystalline sodium tribasic phosphate and 3 percent anhydrous sodium chromate. After treatment the tape or wire is washed free of solution, dried at about 150°C. and then cooled, preferably in an inert medium such as carbon tetrachloride. The film so obtained combines hardness and ductility to withstand normal handling, together with good insulation properties, but the articles may be impregnated or coated by a varnish, lacquer or wax to give further protection from water. If desired, the treatment of wire or tape by this process may be carried out in a continuous manner. ROBERT B. GOODSELL

COPIES OF PROCEEDINGS

Copies of the Proceedings of the 1941 Convention have been sent to the Branch Secretaries for distribution. If your branch has not received the right number of copies so that each member in good standing at the close of the fiscal year shall receive one, please write us. We have extra copies available. There are also some copies to be sold. These may be purchased for $5 per copy.

Past President Fred Fulforth has severed his connection with the Proctor Electric Co. He has accepted a position in the Manufacturing Executive office of Sperry Gyroscope Co., Brooklyn. His many friends wish him every success although his work is not entirely connected with plating.

DEATH OF A. P. MUNNING

The many members of the A.E.S. who knew him will deeply regret the passing away of Mr. A. P. Munning of the Hanson-Van Winkle-Munning Co. after several months' illness. Mr. Munning was buried in Brooklyn, N. Y., on Monday, November 3. He was 69 years old. Our deepest sympathy is hereby extended to his widow and daughter, Mrs. John Bowers of Matawan, N. J.

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THE QUESTION BOX

Indianapolis Branch

1. *Is it necessary to degrease copper before painting?*

Ans. (W. R. Binai) Degreasing is inadequate. To produce a chemically clean surface, it is necessary to alkali clean, hot rinse, and air dry.

2. *What are some possible sources of pitting or other surface roughness of Rochelle copper plating over cast iron?*

Ans. (R. M. Wagner) Possible sources are: the base metal, wheel marks or polishing grit, tears from polishing, particles in the plating bath, hard water salts, low free cyanide content, high temperature, and the surface of the cast iron not being uniformly conductive.

3. *Will boiling copper in water for three or four hours remove the oxygen and prevent discoloration?*

Ans. (T. K. Allison) Neither boiling nor pickling will remove oxygen. Copper sulphite is the worst discoloring compound.

4. *In what direction does chromium throw on the work—opposite the anode or in all directions?*

Ans. (E. L. Buell) Hang anodes parallel to work surface if possible.

(W. R. Binai) Current takes the path of least resistance.

(R. M. Wagner) Anodes should be convex toward the cathode for uniform plating on a flat surface. (See work of Dr. Cotton—Delco-Remy).

(J. M. Cosgrove) For uniform plating use a helper or auxiliary cathode.

EZRA A. BLOUNT, *Secy. Protem*

Detroit Branch

1. *What should be the threshold limits in ventilation for copper cyanide, bright nickel, chromium, high speed copper, and acid copper solutions?*

Ans. About 150 cu. ft. per min. for cyanide copper, bright nickel, high speed copper and acid copper. For chromium solutions this should be about 250 cu. ft. per min.

2. *Is there an immersion plate that can be put on copper giving a metal similar or nearly similar to chromium?*

Ans. Yes. Either silver or tin are similar in appearance.

3. *What coating or covering can be placed over a lead covered tank that will protect it against a cyanide zinc solution?*

Ans. Have the tank lined with sheet iron or steel over the lead.

4. *How could a black color be provided on a red brass of the following composition?*

Tin	— 5%
Lead	— 5%
Zinc	— 5%
Copper	— 85%

Ans. It could be black nickel plated or plated with copper and then oxidized with sulphide.

5. *What is a practical method for removal of chlorides when using insoluble anodes in a nickel tank, so that brighteners will not be destroyed by free chlorine?*

Ans. For ordinary dull solution, without organic additions present, the chlorides can be removed by Electrolysis with insoluble anodes at a high temperature. For bright solution with organic brighteners, no method was suggested.

EDGAR A. HAHN, *Librarian*

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ADEQUATE RESERVES READY FOR PROMPT SHIPMENT

Los Angeles Branch

1. *Is the pH of a silver solution important? What should it be? If too low how can it be raised?*

Ans. pH should be about 11. Sodium cyanide will keep it up.

2. *How can cylindrical shaped parts be hard chrome plated so that the plate will be even without burning at the edges?*

This question can be answered in so many ways that the only definite answer is to have proper temp. about 110 F. Solution concentration 52 oz. per gal. and proper racks which depend on the dimensions of work.

ERVIN FRAUENHOFF, *Secy.*

Detroit Branch

1. *What effect, if any, has a rectifier on power factor?*

Ans. The power factor of a copper oxide rectifier is 96% at full load.

2. *How close will the voltage regulation be from half load to full load under continuous operation such as variable loading of a continuous plating conveyor?*

Ans. Voltage regulation of a copper oxide rectifier from half load to full load is 12½%.

3. *How does the voltage of a copper oxide rectifier at 5% load compare with the voltage at maximum load?*

Ans. The voltage at 5% load is 7.4 volts as compared with 6 volts at maximum load.

4. *Will the rectifier stand up in the fumes from a chromic acid anodizing process?*

Ans. A rectifier, in common with other electrical equipment cannot be expected to give good service or long life unless fumes are carefully exhausted.

5. *How do you reduce cupric oxide to metallic copper? In so doing do you change the layer of cuprous oxide?*

Ans. The cupric oxide is reduced by chemical means. In this reduction a small part of the cuprous oxide is removed.

6. *How would you set up a copper oxide rectifier delivering 2000 amperes at 18 volts for use with a sulphuric acid anodizing process?*

Ans. This can be done using three banks, in series, of four 500 ampere rectifiers connected in parallel.

7. *What determines the luster of black nickel deposit?*

Ans. The luster of black nickel deposit is determined by current density and zinc content of bath.

8. *How does the pH affect copper cyanide solution in respect to:*

1. *Anode corrosion*
2. *Throwing power*
3. *Color of plate.*
4. *Softness of plate.*

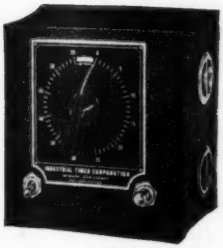
Ans. It was the concensus of opinion of the group that anode corrosion and throwing power would be adversely affected by a rise in pH. Color of plate would gradually shift from salmon to deep red with increasing pH. The plate would tend to become harder with increase in pH value.

9. *What is a successful method for cleaning casket hardware metal of composition 85% lead, 13% antimony, and 2% copper, to secure adherence of copper, nickel and chrome sufficient to stand baking at 250 °F.?*

Ans. It was suggested that a satisfactory cycle consists of degreasing in organic solvent, followed by a mild alkali cleaner, electrolytic pickle, and copper plating in a copper cyanide solution, possibly with mechanical scrubbing included in the cycle. In dealing with alloys of this nature, it must be remembered that they are very susceptible to hydrogen embrittlement, and it may be difficult to remove because of the low melting point of the alloy.

EDGAR A. HAHN, *Librarian.*

Signalling TIMERS



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Rochester Branch

1. *Express the solubility of antimony lead in various strengths of alkalis.*

Ans. For all practical purposes it is insoluble.

2. *What formula could be used that will give a whitish pink gold plate?*

Ans. Such a formula would be composed of an alloy of nickel, copper and gold.

3. *What salts could be substituted for nickel sulfate in a dull nickel solution?*

Ans. The carbonate or hydroxide of nickel could be neutralized or hung in solution and allowed to dissolve gradually. Nickel chloride up to 10 oz. per gal. can be used in a hot solution and up to 6 oz. in a cold sol. A greater amount would cause a brittle plate. Acetate and formate up to about 4 oz. per gal. in a hot solution might be used.

4. *What is a good solution for passivating stainless steel for optical frames?*

Ans. A 50-50 nitric acid dip for a few seconds should suffice. For stubborn cases a less concentrated hot solution may be employed. For 18-8 stock a thirty to sixty minute dip at room temperature is good practice. Some commercial solutions for anodic polishing are also employed.

5. *What is a good bright dip formula for brass prior to nickel plate?*

Ans. The standard dip of two parts of H_2SO_4 to one of HNO_3 plus a little water or a little of the old dip to start a new one.

6. *Suggest a method of descaling steel without appreciably removing any stock.*

Ans. One method would be to use the Bullard-Dunn process. Use a 50% hot hydrochloric dip. Inhibitors if used must be used in a properly balanced solution to be effective.

7. *How can nickel be removed from a cadmium solution?*

Ans. Plate out at low current densities 2 to 5 Amps./Sq. Ft. This is of course a slow process. (By the use of sponge cadmium). A new process employing Amberlite IR-1 and Darco carbon will remove all the metallic impurities but will also remove some of the cadmium.

8. *What is a good non-pitter for a nickel solution?*

Ans. Hydrogen-Peroxide.

9. *What is the procedure for preparing nickel silver prior to nickel plating?*

Ans. A 10-20% sulfuric solution with reverse current for 10 to 30 seconds can be used. Any discoloration may then be removed by a subsequent cyanide dip and cleaning cycle. A nickel or copper strike may also be used.

10. *How can fire scale be removed from tempered steel for small work?*

Ans. Inhibited acids and reverse sulfuric strip suggested. In difficult cases a solution of fuming nitric was suggested.

11. *What is the best treatment to follow in plating low grade leaded brass?*

Ans. A copper strike or if unavailable a 30 second dip in 100% hydrochloric dip should work successfully.

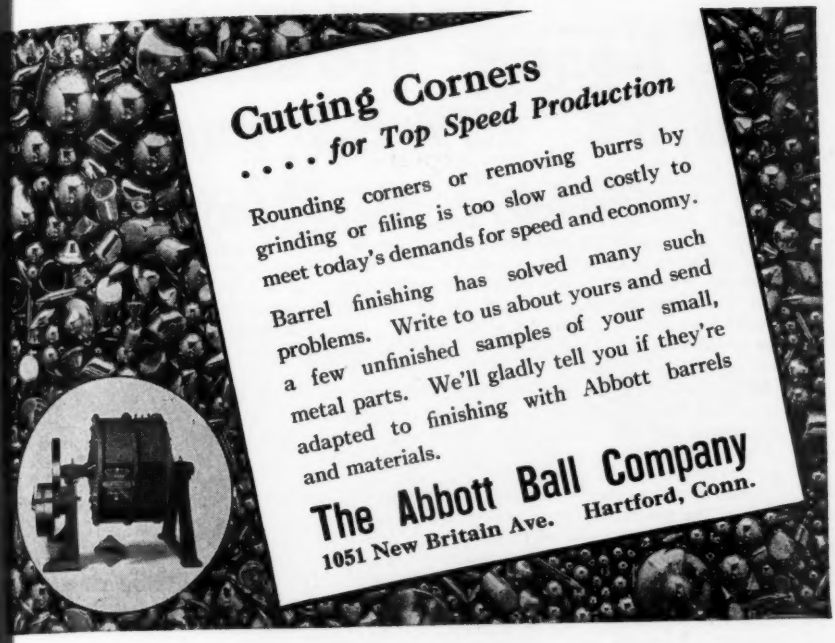
12. *What is the accepted standard for decorative chromium deposits?*

Ans. One to two hundred thousandths.

13. *Explain the scientific theory of anodic cleaning.*

Ans. Essentially it allows the cleaning action to penetrate more deeply because it removes surface films impossible to remove any other way. This is due to the high current densities employed which in turn are made possible because of higher concentrations.

JUDSON R. ELSTER, *Secy.*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LETTER TO THE OPM REGARDING REPRESENTATION OF THE A.E.S. AT WASHINGTON

Mr. Jas. T. Kemp,
Office of Production Management,
Room 5326 Social Security Building,
Washington, D.C.

Subject: Electroplating Industry.

Dear Mr. Kemp:

At a meeting of the Research Committee of the American Electroplaters' Society, held at the National Bureau of Standards on September 12, the suggested meeting to plan the representation of the electroplating industry before the OPM was endorsed. Since then I have been requested by Mr. E. T. Candee, President of the American Electroplaters' Society, to transmit to you the following suggestions and list of firms and organizations that might be invited to this preliminary conference. It was suggested that the meeting be arranged for a Friday in October, e.g., October 10, 17, or 24, at your convenience.

Electroplating is applied to such diverse products that there is no trade organization of that industry. The only society that represents the entire electroplating industry is the American Electroplaters' Society, composed chiefly of foremen platers, chemists, and engineers. Even though this organization is not in a position to commit the firms in this industry to a specific course, it can properly initiate steps to provide for the appropriate representation of the entire industry.

The operation of the electroplating industry to meet both defense needs and civilian requirements involves adequate supplies of metal anodes, e.g. of nickel, copper, zinc, cadmium, lead, tin, and silver. In addition it consumes such chemicals as chromic acid, nickel sulfate, copper sulfate and cyanide, zinc sulfate and cyanide, cadmium cyanide, silver cyanide, sodium and potassium cyanide, Rochelle salt, citric acid, hydrochloric, sulfuric and nitric acids, sodium hydroxide, carbonate, phosphate and silicate. Polishing wheels and abrasives are also used. Electric generators or rectifiers, with their auxiliary equipment, and also tanks and conveyors are required for new installations.

The functions of an advisory committee will no doubt include the compilation of data on the requirements for these and other materials, the availability of substitutes, and the proper allocation and distribution of such amounts as are made available. The chief purpose of the preliminary meeting will presumably be to plan the organization of an advisory committee that can fulfill these functions.

The government departments, especially War and Navy, now consume large amounts of plated articles, both for strictly military uses and for non-military but essential needs, such as tableware, cooking utensils, hardware, and plumbing fixtures, All of these requirements must be considered in order to properly allocate materials for use in plating. Representatives of not only the OPM but also the Federal Specifications Executive Committee, and the National Bureau of Standards should therefore be invited to this organization meeting.

The following list of organizations and firms is by no means complete, but with minor additions that will occur to you it may serve as a basis for the preliminary meeting.

A — Organizations

1. American Electroplaters' Society.
   Pres., E. T. Candee, American Brass Co., Waterbury, Conn.
   Ex. Sec., W. J. R. Kennedy, 93 Oak Grove Ave., Springfield, Mass.
   Chairman of Research Com., Erwin Sohn, American Radiator and Standard Sanitary Corp., Louisville, Ky.
2. Aircraft Manufacturers Asso., 30 Rockefeller Plaza, New York, N. Y.
3. Automobile Manufacturers Association, 366 Madison Ave., New York, N. Y. (Bumper manufacturers).
4. American Iron and Steel Institute, 350 Fifth Ave., New York, N. Y.

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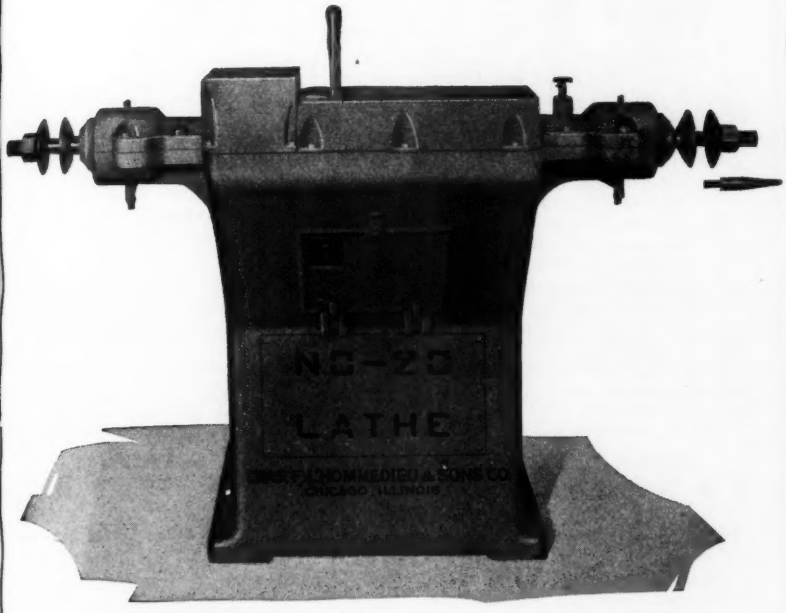

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Detroit

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5. Buff and Polishing Wheel Manufacturers Association, 110 E. 42nd St., New York, N. Y.
6. Hardware Manufacturers Association, 342 Madison Ave., New York, N. Y.
7. Master Electroplating Association (Job Platers), 123 William St., New York, N. Y.
8. Master Electroplaters' Institute (Job Platers), 7320 Hamilton Ave., Detroit, Mich.
9. National Electric Manufacturers Association, 155 E. 44th St., New York, N. Y.
10. Sanitary Brass Manufacturers Association (Plumbing Fixtures), 910 Clark Bldg., Pittsburgh, Pa.
11. Silverware Manufacturing Institute, 20 W. 47th St., New York, N. Y.

B — Electroplating Supplies

1. Apothecaries-Hall Co., Waterbury, Conn.
2. Crown Rheostat and Supply Co., 1910 Maypole Ave., Chicago, Ill.
3. E. I. DuPont de Nemours and Co. (Electroplating Division), Wilmington, Del.
4. Hanson-Van Winkle-Munning Co., Matawan, N. J.
5. Harshaw Chemical Co., Cleveland, Ohio.
6. International Nickel Co., New York, N. Y.
7. McGean Chemical Co., Cleveland, Ohio.
8. Mutual Chemical Co. of America, 270 Madison Ave., New York, N. Y.
9. Seymour Manufacturing Co., Seymour, Conn.
10. Frederic B. Stevens Co., Detroit, Mich.
11. Udylite Corp., Detroit, Mich.
12. United Chromium, Inc., 51 E. 42nd St., New York, N. Y.
13. U. S. Galvanizing and Plating Equipment Corp., 31 Heyward St., Brooklyn, N. Y.

I hope that the OPM will take steps to call such a conference. I will be glad to cooperate with you in every possible way in making the arrangements.

—WILLIAM BLUM, CHEMIST

ORDER EXTENDS NICKEL CONTROL; U. S. FACES RISING SHORTAGE

From *Defense*, October 7, 1941

The United States faces a nickel shortage for 1941 of something like 40 million pounds. Next year it is expected that the shortage will go higher, perhaps as high as 60 or 70 million pounds. Because of this prospect, the Division of Priorities issued September 30 General Preference Order M-6-a, extending priority control over nickel to March 31, 1942.

In the new order it is provided that the Director of Priorities, as heretofore, will continue to allocate primary nickel among competing consumers. The allocations of nickel are made each month after examination of proposed shipments and apparent requirements.

DATA ON METALS

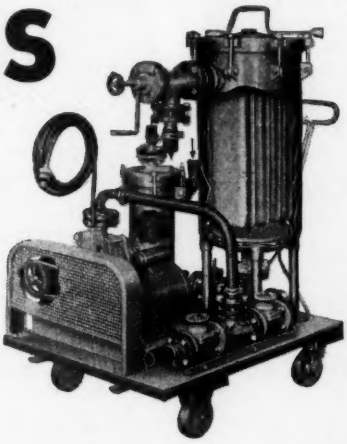
We are indebted to Dr. Blum for furnishing us with the following tables which were recently compiled.—Ed.

TABLE 1
Normal World Production of Metals
(Based on 1939 Values in 1940 Minerals Yearbook)

Metal	Annual Production short tons	Ratio of Production	cents/ lb.	dollars/ ton	Total Value Million Dollars	Ratio of Values
Gold	1,300	1	($35 oz)	1,000,000	1,300	325
Bismuth	1,500	1.2	125	2,500	4	1

Continued on Page 932

FILTERS



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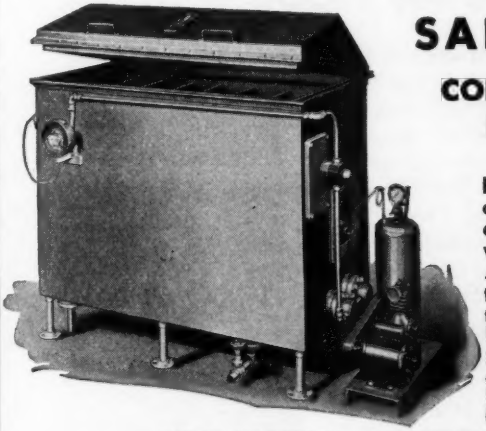

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For testing—Electroplated or coated metals at 95 deg. Fah. in accordance with Army, Navy and Aeronautical specifications, as outlined in Bulletin AN-QQ-S-91-5 dated Dec. 1938. Also for controlled temperatures at any degree. Testing Cabinets lined throughout with rubber. Made in 4 sizes.

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Vanadium	3,000	2.3	300	6,000	18	4.5
Cadmium	4,200	3	65	1,300	5	1.2
Cobalt	6,000	5	150	3,000	18	4.5
Silver	10,000	8	45(oz)	13,500	135	34
Tungsten	15,000	12	200	4,000	60	15
Molybdenum	17,000	13	100	2,000	34	8
Antimony	32,000	25	12	240	8	2
Magnesium	33,000	25	30	600	20	5
Nickel	120,000	90	35	700	84	17
Tin	195,000	150	50	1,000	195	50
Chromium	200,000	150	20	400	80	20
Aluminum	735,000	550	20	400	300	75
Zinc	1,800,000	1,400	5	100	180	45
Lead	1,700,000	1,300	3	60	100	20
Manganese	2,000,000	1,500	7.5	150	300	75
Copper	2,000,000	1,500	11	220	440	110
Iron	110,000,000	85,000	1	20	2,200	550

TABLE 2
Approximate Percentages of Total U.S. Consumption Normally Applied in Metal Coatings

Metal	Electroplating	Hot Dipping	Sherardizing
Lead	0.01	1	
Copper	0.1		
Zinc	1	40	0.1
Tin	1	40	
Chromium	1		
Nickel	7		
Silver	10		
Cadmium	50		

TABLE 3
Annual Consumption of Nickel Anodes

Classification	Number of Firms	Nickel Used in 1940 lbs.	Percent of Plated Nickel
Automobiles	83	$7,888,000	62.2
Electrical Household Appliances and Electric Lights	43	790,362	6.2
Metal Furniture and Accessories	13	394,214	3.1
Tools and Machines	41	236,622	1.9
Builders' Hardware	29	201,210	1.8
Plumbing Fixtures	23	204,058	1.6
Bicycles, Skates, Toys, Cameras, and Sporting Goods	28	205,274	1.6
Wire Products, Eyelets, Pins	28	188,924	1.5
Business Machines, Typewriters	14	162,866	1.3
Handbags and Novelties	11	152,058	1.2
Utensils, Serving, Cooking & Tableware	11	152,439	1.2
Sheet and Strip	4	142,486	1.1
Communications, Radio, T. & T., Phonographs	9	55,004	.4
Electrotyping	14	52,100	.4
Jewelry and Clocks	7	50,371	.4
Special Electroforming and New Developments	6	52,009	.4
Stoves	7	23,875	.2
Job Platers	103	569,896	4.5
Unclassified for lack of data	44	368,991	2.6
Under 2,000 lbs.	1645	812,923	6.4
TOTALS	2163	$12,705,285	100.00%

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Add acid to water; — allow to cool to 120°F. Add Bryt-Dip while stirring thoroughly. Use the solution at room temperature. Time of immersion varies between twenty seconds and three or four minutes, depending on work. This makes a concentrated solution. If a weaker solution is desired, add water. Prices are 25 lbs. — .25 a lb., 50 lbs. — .22 a lb., 100 lbs. — .19 a lb., 200 lbs. — .17 a lb., F.O.B. Detroit, J. J. Siefen Company.

ASTM PUBLISHES PLATING SPECIFICATIONS

American Society for Testing Materials, in cooperation with American Electroplaters Society, has now issued another edition of their collection of plating specifications. The new collection includes Electrodeposited Coatings of Zinc (A 164-40T) and Cadmium (A 165-40T) on Steel, unchanged from last year; Electrodeposited Coatings of Nickel and Chromium on Steel (A 166-41T), which has been revised considerably; two new specifications on Electrodeposited Coatings of Nickel and Chromium on Copper and Copper-Base Alloys (B 141-41T), and on Zinc and Zinc-Base Alloys (B 142-41T); and the slightly revised Local Thickness of Electrodeposited Coatings (A 219-40T).

Copies of this collection can be obtained at 25¢ each by writing to the American Society for Testing Materials, 260 South Broad Street, Philadelphia, Pennsylvania. Constructive criticism of these specifications is solicited. Comments should be directed to the above address for remittal to the Committees in charge.

It is recognized by Committee B-8 on Electrodeposited Metallic Coatings that in many instances it is impossible to use as much nickel as required by A 166-41T, B 141-41T and B 142-41T. However, rather than changing the specifications, it is suggested that the total minimum thickness specified be adhered to, and that copper be used to take the place of the nickel which cannot be gotten. It is common practice to leave out the nickel entirely when indoor uses are concerned, and to apply at least .0003″ of nickel, or as much thereof as is available, over the copper for outdoor use.

B-L METALLIC RECTIFIER VOLTAGE REGULATOR

The Benwood Linze Co., St. Louis, Mo., has developed a competitively priced voltage regulator, to be used in conjunction with its line of standard metallic rectifier electroplating units. The B-L voltage regulator, manually operated, provides a convenient and simple means for adjusting the voltage output of each individual or bank of rectifiers. It is available in a wall mounting cabinet so it may be installed adjacent to the plating tank within convenient reach of the operator and away from the rectifier units.

There are 64 steps of adjustment, giving a voltage range from maximum down to one volt. The coarse control covers the full range in eight steps while the fine control provides eight steps for each step of the coarse control. In addition, the regulator provides a start-stop station permitting remote control for starting and stopping the rectifier, thereby giving the operator complete control of each tank.

In the front of the unit are two accurate, easily read meters, sealed to protect against moisture and dust. One voltmeter and one ammeter record current and voltage of each individual rectifier. By this method of control, all the convenience of an individual tank rheostat is obtained, but the rheostat losses of bus bar control are eliminated. The elimination of no-load losses is possible due to the fact that the operator can shut down the rectifier whenever a tank is not in use. Descriptive literature and prices may be obtained from the manufacturer.

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Wyandotte M.K. 50 cleans *all* metals and will not attack *any* metal — aluminum, magnesium, copper, brass, zinc or cadmium.

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Why not call in your Wyandotte Representative and have him check over your cleaning operations? The chances are he can save you time and money. He may show you a short cut or a new cleaner.

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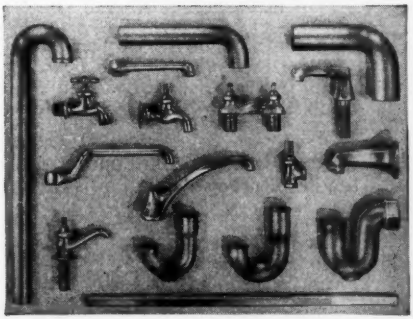

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Membership Report

MAURICE R. CALDWELL, *Chairman, Membership Committee*

To November 1, 1941

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Ernest D. Callahan, 34 Marshall Ave., Malden, Mass.

Chicago Branch

F. G. Berquist, 154 W. North Ave., Chicago, Ill. Associate

Cleveland Branch

Charles J. Foley, 10607 Harvard Ave., Cleveland, Ohio. Active
George H. Carter, 2000 West 14th Street, Cleveland, Ohio. Associate
Henry Bloser, 1710 Corning Ave., Cleveland, Ohio. Associate

Dayton Branch

Eugene L. Combs, 372 E. Oakland Ave., Columbus, Ohio. Associate
Eugene Cotton, 1361 Morning Ave., Columbus, Ohio. Active
Anthony Cira, 459 N. Main St., Lima, Ohio. Associate
George Loesch, 316 N. Lawnview Circle, Mansfield, Ohio. Active

Detroit Branch

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Grand Rapids Branch

Clifford E. Crouch, 1330 Rice Street, Elkhart, Indiana. Active
William Ernest Fryover, R.F.D. #3, Lowell, Michigan. Associate
Owen D. Guthrie, 610 Worden St., S. E., Grand Rapids, Michigan. Active
Louis John Przybylski, 922 Scribner, Grand Rapids, Michigan. Associate

Hartford Branch

George Meadows, 106 Bond Street, Hartford, Conn. Associate
Stanley Rutkowski, 24 Lewis Street, Torrington, Conn. Associate

Lancaster Branch

Oscar E. Border, International Chain & Mfg. Co., York, Pa. Active
Theodore D. Gaul, 1833 Cotton Street, Reading, Pa. Active
Frank Weaser, 539 S. 18th Street, Reading, Pa. Active

New Haven Branch

Arthur Ayotte, 6 Rugby St., Stamford, Conn. Active

Pittsburgh Branch

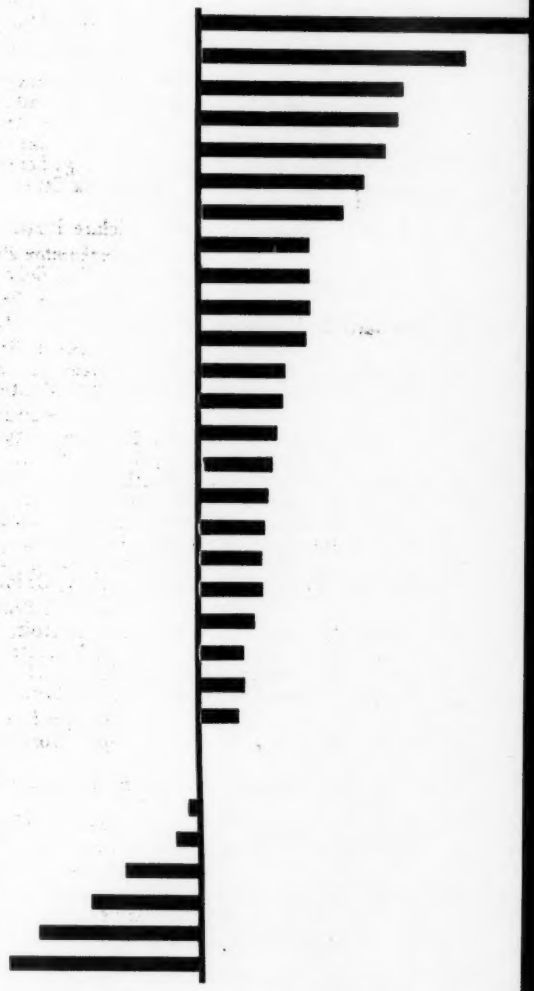
Helmer Bengston, 409 Keystone Drive, New Kensington, Pa. Associate
Byron Victor McBride, Tenth St., Irwin, Pa. Associate

Toronto Branch

R. J. Atkinson, 196 Dufferin St., E., Weston, Ont., Can. Associate
C. J. McKee, 50 Robinson St., Winnipeg, Can. Associate
C. J. Emberley, 139 Monarch Pk. Ave., Toronto, Ont., Can. Active
G. G. Harris, 621 Beresford Ave., Toronto, Ont., Can. Associate

MEMBERSHIP CAMPAIGN REPORT

BRANCH	May 1, 1941	Change in Membership	Percent Change
San Francisco	38	+8	+21.1
Hartford	48	+8	+16.7
Balt.-Washington	43	+5½	+12.8
Toronto	66	+8	+12.1
Pittsburgh	43	+5	+11.6
Montreal	29	+3	+10.3
Bridgeport	72	+6½	+ 9.0
Boston	102	+7	+ 6.9
Prov.-Attleboro	44	+3	+ 6.8
Toledo	44	+3	+ 6.8
Los Angeles	121	+8	+ 6.6
New York	121	+6½	+ 5.4
Dayton	79	+4	+ 5.1
Newark	136	+6½	+ 4.8
Bing.-Syracuse	22	+1	+ 4.5
Buffalo	49	+2	+ 4.1
Waterbury	87	+3½	+ 4.0
Rochester	76	+3	+ 3.9
Cleveland	80	+3	+ 3.8
Chicago	234	+8	+ 3.4
Indianapolis	39	+1	+ 2.6
Grand Rapids	77	+2	+ 2.6
Detroit	260	+6	+ 2.3
Milwaukee	92	0	0
Anderson	40	0	0
New Haven	100	— ½	— .5
St. Louis	79	—1	— 1.3
Lancaster	44	—2	— 4.5
Cincinnati	53	—3½	— 6.6
Springfield	69	—7	—10.1
Philadelphia	150	—18	—12.0



NOTE: Honorary members are included with each Branch.

MEMBERSHIP — May 1st, 1941 = 2537
MEMBERSHIP — Nov. 1st, 1941 = 2617
GAIN IN MEMBERSHIP 80
GAIN = 3.1%

Waterbury Branch

Roy A. Anderson, 1 Central Ave., Waterbury, Conn. Associate
Emile J. Beloin, 32 George St., Bristol, Conn. Associate
Jacob Hyner, 61 Elmwood Ave., Waterbury, Conn. Associate
Walter R. Ruefli, Winsted Rd., Torrington, Conn. Associate
Stuart E. Judd, P. O. Box 1528, Waterbury, Conn. Associate

APPLICATIONS

Baltimore-Washington Branch

Samuel Asrael, 411 N. Exeter Street, Baltimore, Md. Active
Irvine Clayton Clingan, 3400 E. Chase Street, Baltimore, Md. Active
Royal J. Gregory, Levering Avenue, Elkridge, Md. Active
Robert Louis McGill, 106 E. Gittings Street, Baltimore, Md. Associate
Llewellyn Glenn Tubbs, 1348 Block Street, Baltimore, Md. Associate
Lenard Peter Walsh. Active
James W. Elston, Jr., 7034 Belclare Road, Dundalk, Md. Associate

Binghamton Branch

Duane Lawton, Pass & Seymour Co., Solvay, N. Y. Associate

Bridgeport Branch

Richard T. Haubrich, 82 Horace Street, Stratford, Conn. Active

Cincinnati Branch

Robert B. Purkiss, Batesville Casket Co., Batesville, Ohio. Active
Oscar Rey Varela, Angel Salvo 242, Montevideo, Uruguay, S. A. Associate

Dayton Branch

E. H. Luaces, Toulmin and Toulmin, Attys., Dayton, Ohio. Associate
M. C. Jewett, Stolle Corp., Sidney, Ohio. Associate
Arthur J. German, 3015 Southern Blvd., R. R. #7, Dayton, Ohio. Associate
Charles L. Faust, Battelle Memorial Inst., Columbus, Ohio. Associate
Albert H. Hannon, 1905 N. Fountain Blvd., Springfield, Ohio. Associate
Werner Bensman, R. R. #1, Anna, Ohio. Associate
R. H. Tate, 815 N. Broadway, Dayton, Ohio. Associate
Herman Baker, Stolle Corp., Sidney, Ohio. Associate

Detroit Branch

George A. Lodge, 7431 Burnette, Detroit, Mich. Active
Donald A. Gaines, 5657 Lauderdale, Detroit, Mich. Associate
Robert H. Dudley, 2751 E. Jefferson, Detroit, Mich. Associate
Jerome A. Zengerle, 3484 Cadillac Blvd., Detroit, Mich. Associate

Hartford Branch

Philip M. Nigro, Research Dept., Torrington Mfg. Co., Torrington, Conn. Associate
Clarence S. Rosenbeck, Union Hardware Mfg. Co., Torrington, Conn. Associate
James F. Burns, 523 Hillside Ave., Hartford, Conn. Active
Leonard Edw. Ravich, Royal Typewriter Co., Hartford, Conn. Associate

Rochester Branch

David H. Penn, Hilton, N. Y. Associate
Michael Andrews, 215 Bernard St., Rochester, N. Y. Associate
Arthur A. Chambers, 220 Peart Ave., Pt. Pleasant, N. Y. Associate

Springfield Branch

Emil Bonanate, 751 East St., Pittsfield, Mass. Associate
Joseph F. Guitian, 567 East St., Pittsfield, Mass. Associate
Capt. Herbert S. Gronski, Watervliet Arsenal, Watervliet, N. Y. Associate
Frank W. Drake, 1420 Sixth Ave., Watervliet, N. Y. Active

Toronto Branch

H. Brock, 255 Annette St., Toronto. Active
G. Gresswell, c/o Bond & Boyd, 251 Spadina Ave., Toronto. Associate
S. R. McLeod, 575 St. Clarens Ave., Toronto. Associate
J. Vaughan, 88 South Drive, Toronto. Associate
S. G. Childs, 58 Park Dale Road, Toronto. Active